INSTRUCTION MANUAL

MODEL 145
20 MHz FUNCTION/ PULSE GENERATOR

WAVETEK

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20 MHz FUNCTION/ PULSE GENERATOR

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SAFETY

This instrument is wired for earth grounding via the facility power wiring. Do not bypass earth grounding with two wire extension cords, plug adapters, etc.

BEFORE PLUGGING IN the instrument, comply with installation instructions.

MAINTENANCE may require power on with the instrument covers removed. This should be done only by qualified personnel aware of the electrical hazards.

WARNING notes call attention to possible injury or death hazards in subsequent operations.

CAUTION notes call attention to possible equipment damage in subsequent operations.

SECTION 1
GENERAL DESCRIPTION

1.1 THE MODEL 145

The Model 145 20 MHz Pulse/Function Generator has the versatility of output found in a function generator, plus the pulse characteristics of a pulse generator. It is a precision source of sine, triangle, balanced square, positive square and negative square waveforms, a source of dc levels and a source of normal and inverted pulses. All are front panel and remote control variable in frequency from 0.0001 Hz to 20 MHz (periods from 50 ns to 10,000s). Pulse widths are variable from 25 ns to 1 ms and pulse delays variable from 50 ns to 10 ms. Double pulses (two pulses per period) are also available with variable time between pulses. The logical complement of the pulse is selectable and either pulse or complement are output simultaneously as ECL, $\overline{\text{ECL}}$, TTL, $\overline{\text{TTL}}$ and variable amplitude and offset pulses.

The amplitude controllable output of either waveform or pulse can be varied up to 30 volts peak-to-peak (open circuit) and attenuated up to 80 dB. DC voltage or dc offset of signal is variable by front panel control and by external control between ±15 volts (open circuit). The outputs are also triggerable for one or multiple cycles by front panel switch or remote signal. A voltage representing generator frequency and a TTL level sync pulse at the frequency of the generator are auxiliary outputs.

1.2 SPECIFICATIONS

1.2.1 Versatility

Instrument operates as either a function generator or pulse generator.

1.2.2 Function Generator

Waveforms
Selectable sine ∿ , square ⊓ , triangle △ , positive square ⎍ , negative square ⎎ and dc. TTL sync pulse and fixed amplitude pulses of TTL, $\overline{\text{TTL}}$, ECL and $\overline{\text{ECL}}$, all simultaneously available with function output.

Operational Modes
Continuous: Generator oscillates continuously at selected frequency.
Triggered: Generator is quiescent until triggered by an external signal or manual trigger, then generates one cycle at selected frequency.
Gated: As triggered mode, except generator oscillates for the duration of the gate signal.

Frequency Range
0.0001 Hz to 20 MHz in 10 overlapping ranges with approximately 1% vernier control.

Function Output
∿, ⊓, △ selectable and variable to 30V p-p (15V p-p into 50Ω). ⎍ , ⎎ , to 15 Vp (7.5 Vp into 50Ω). All waveforms and dc can supply 150 mA peak current and may be attenuated to 60 dB in 20 dB steps with an additional 20 dB vernier.

DC Output and DC Offset
Selectable thru FUNCTION OUT output. Controlled by front panel control or by applying an external voltage. Adjustable between ±15 Vdc (±7.5 Vdc into 50Ω) with signal peak plus offset limited to ±15 Vdc (±7.5 Vdc into 50Ω). External offset sensitivity approximately −1 V/V with output into open circuit. DC offset and output waveform attenuated proportionately by the 60 dB output attenuator.

Sync Output
A TTL level pulse. Will drive 50Ω termination.

GCV — Generator Controlled Voltage
At GCV OUT connector, a 0 to +2V signal proportional to generator frequency. 600Ω source impedance.

VCG — Voltage Controlled Generator
Up to 1000:1 frequency change with external 0 to 2 volt signal to VCG IN connector. Upper and lower frequencies limited to maximum and minimum of selected range.
Slew Rate: 2% of range per μs.
Linearity:
±0.2% for 10 Hz to 100 kHz.
±0.75% for 0.001 Hz to 2 MHz.
Impedance: 2 kΩ.

Trigger and Gate
Input Range: 1V p-p to ±10V.

Impedance: 10 kΩ, 33 pF.
Pulse Width: 25 ns minimum.
Repetition Rate: 10 MHz maximum.
Adjustable Triggered Signal Start/Stop Point (sine and triangle only): Approximately −90° to +90° to 2 MHz.

1.2.3 Frequency Precision

Dial Accuracy
±3% of full range from X .01 Hz to X 1 MHz.
±5% of full range on X 10 MHz.

Time Symmetry
Square wave variation less than:
±1% from 0.001 Hz to 200 kHz
±0.5% from 20 Hz to 20 kHz

1.2.4 Amplitude Precision

Amplitude Change With Frequency
Sine variation less than:
±0.1 dB for 0.001 Hz to 200 kHz
±0.5 dB for 200 kHz to 2 MHz
±3.0 dB for 2 to 20 MHz

Step Attenuator Accuracy
0.3 dB per 20 dB step at 2 kHz.

1.2.5 Waveform Characteristics

Sine Distortion
< 0.5% on X 100 Hz to X 10 kHz.
< 1.0% on X .01 to X 10 Hz and X 100 kHz.
All harmonics 34 dB below fundamental on X 1 MHz.
All harmonics 26 dB below fundamental on X 10 MHz.

Square Wave Rise/Fall Times
At FUNCTION OUT < 20 ns for 15V p-p output into 50Ω load.

1.2.6 Pulse Generator

Pulse Outputs
Variable amplitude pulse, and simultaneous fixed ECL, $\overline{\text{ECL}}$, TTL and $\overline{\text{TTL}}$ pulses and TTL sync pulse. All outputs can drive 50Ω terminations.

Operational Modes
Continuous, triggered and gated plus the following.
Normal Pulse: Adjustable width pulse in phase with sync signal.
Delayed Pulse: Pulse delayed with respect to normal pulse. Pulse delay and pulse width adjustable.
Double Pulse: Two pulses for every period. Time between pulses and pulse width adjustable. Minimum period 100 ns.

Pulse Period Range
50 ns to 10,000s in 10 overlapping ranges with approximately 1% vernier control.

Pulse Width
25 ns to 1 ms in 5 overlapping ranges with vernier control. Includes OFF and square wave.

Pulse Delay
50 ns to 10 ms in 6 overlapping ranges with vernier control.

Duty Cycle
Duty cycles to 70% for periods > 100 ns (< 10 MHz); for periods < 100 ns (> 10 MHz) duty cycles are approximately 50%.

Function Output
Variable to 30V p-p (15V p-p into 50Ω). DC offset and attenuation are same as for function generator.

Pulse Rise/Fall Times
At FUNCTION OUT, < 20 ns for 15V p-p output into 50Ω load.

1.2.7 General

Stability
Short Term: ±0.05% for 10 minutes.
Long Term: ±0.25% for 24 hours.
Percentages apply to amplitude, frequency and dc offset.

Environmental
Specifications apply at 25°C ±5°C. Instrument will operate from 0°C to 50°C ambient temperatures.

Dimensions
28.6 cm (11¼ in.) wide; 14.5 cm (5¾ in.) high; 27.3 cm (10¾ in.) deep.

Weight
5 kg (11 lb) net; 6.6 kg (14½ lb) shipping.

Power
90 to 105V, 108 to 126V, 198 to 231V and 216 to 252V selectable; 48 to 400 Hz; less than 30 watts.

NOTE

All specifications apply from 0.1 to 2.0 on frequency dial when FUNCTION OUT output is at maximum and 50Ω terminated. Function generator specifications apply when PULSE WIDTH control is OFF.

SECTION 2
INSTALLATION

2.1 MECHANICAL INSTALLATION

After unpacking the instrument, visually inspect all external parts for possible damage to connectors, surface areas, etc. If damage is discovered, file a claim with the carrier who transported the unit. The shipping container and packing material should be saved in case reshipment is required.

2.2 ELECTRICAL INSTALLATION

2.2.1 Power Connection

WARNING

To preclude injury or death due to shock, the third wire earth ground must be continuous to the facility power outlet. Before connecting to the facility power outlet, examine extension cords, autotransformers, etc., between the instrument and the facility power outlet for a continuous earth ground path. The earth ground path can be identified at the plug on the instrument power cord; of the three terminals, the earth ground terminal is the nonmatching shape, usually cylindrical.

CAUTION

To prevent damage to the instrument, check for proper match of line and instrument voltage and proper fuse type and rating.

NOTE

Unless otherwise specified at the time of purchase, this instrument was shipped from the factory with the power transformer connected for operation on a 108 to 132 Vac line supply and with a 0.5 amp slow blow fuse.

Conversion to other input voltages requires a change in rear panel fuse-holder voltage card position and slow blow fuse according to the following table and procedure.

Card Position	Input Vac	Fuse
100	90 to 105	0.5 amp
120	108 to 126	0.5 amp
220	198 to 231	0.25 amp
240	216 to 252	0.25 amp

1. Open fuse holder cover door and rotate fuse pull to left to remove the fuse.
2. Select operating voltage by orienting the printed circuit board to position the desired voltage on the top left side. Push the board firmly into its module slot.
3. Rotate the fuse-pull back into the normal position and insert the correct fuse into the fuse holder. Close the cover door.
4. Connect the ac line cord to the mating connector at the rear of the unit and the power source.

2.2.2 Signal Connections

Use 3 foot RG58U 50Ω shielded cables equipped with female BNC connectors to distribute all input and output signals.

2.3 ELECTRICAL ACCEPTANCE CHECK

This checkout procedure is a general verification of generator operation. Should a malfunction be found, refer to the warranty in the front of this manual.

A two channel oscilloscope, four 3 foot 50Ω coax cables with female BNC connectors, a coax tee connector and a function generator are required for this procedure.

Preset the generator front panel controls as follows:

Set up the oscilloscope, Model 145 and external generator as shown in figure 2-1.

Control	Position
Dial	1.0
GENERATOR MODE	CONT
TRIGGER LEVEL	9 o'clock
PULSE DELAY	1 μs ▮ 10 μs
PULSE DELAY VARIABLE	12 o'clock
NORMAL/DOUBLE/DELAYED	NORMAL
PULSE WIDTH	OFF
PULSE WIDTH VARIABLE	12 o'clock
ATTENUATION	0
ATTENUATION VERNIER	Full cw
FUNCTION	⎍
DC OFFSET	OFF
TRIGGER START/STOP	0° CAL
FREQ/PERIOD MULT	1K
VERNIER	Full cw

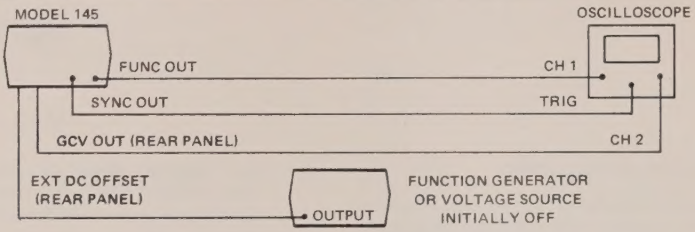


Figure 2-1. Initial Setup

Table 2-1. Acceptance Procedure

Step	Control	Position/Operation	Observe
1	POWER	ON	1 kHz square wave.
2	Dial	Rotate dial. Return to 1.0.	Rotation ccw increases frequency of square on one channel and dc level on other channel; cw decreases frequency and dc level.
3	FREQ/PERIOD MULT	Rotate switch. Return to 1K.	Rotation cw increases frequency; ccw decreases frequency (dc level not affected).
4	VERNIER	Rotate ccw. Return to CAL.	Rotation ccw gives a small decrease in frequency.
5	ATTENUATION	Rotate ccw. Return to 0.	Rotation ccw reduces square wave amplitude.
6	ATTENUATION VERNIER	Rotate ccw.	Square wave amplitude decreases.
7	DC OFFSET	Rotate cw. Return to OFF.	Square wave is immediately offset below previous level; then waveform moves up to a positive level. OFF returns waveform to original position. (Clipping occurs at ±15V.)
8	Function Generator or Voltage Source	Vary input voltage.	Waveform dc level varies.
	Remove EXT DC OFFSET IN cable and connect to VCG IN connector. Remove GCV OUT cable.		
9	Function Generator or Voltage Source	Vary input voltage; then disconnect input.	Frequency increases with increased voltage, decreases with decreased voltage.
10	ATTENUATION VERNIER	Rotate cw.	– – –
11	FUNCTION	Rotate to DC, ∿, ∿, ⊓, ⊓, ⊔, then ∿.	Note dc level on scope. ∿, ∿ and ⊓ should be centered on dc level. ⊓ should rest on dc level, ⊔ should rise to dc level.
12	GENERATOR MODE	GATE	A dc level.
13	MANUAL TRIG	Press down.	A series of sine waves.

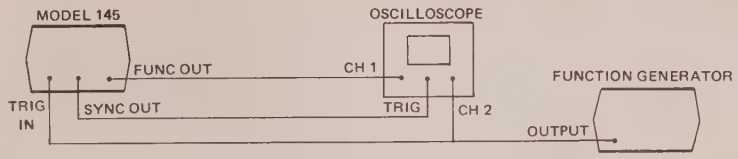


Figure 2-2. Second Setup

Table 2-1. Acceptance Procedure (Continued)

Step	Control	Position/Operation	Observe
	Set up a trigger source as shown in figure 2-2. Trigger on triangle waveform. Set trigger source at 100 Hz ∿ .		
14	TRIGGER LEVEL	Rotate knob. Set for several cycles.	Knob varies number of cycles gated.
15	GENERATOR MODE	TRIG	One cycle per trigger cycle.
16	TRIGGER START/STOP	Rotate knob, then to 0° CAL.	CW starts sine wave at +90°; ccw starts sine wave at −90°. Fully cw gives continuous sine waves.
	NOTE: Select square wave on trigger source.		
17	FUNCTION	PULSE	– – –
18	PULSE WIDTH	Turn cw to 100 μs ▮ 1 ms.	Pulse appears.
19	PULSE WIDTH VARIABLE	Rotate, then to 12 o'clock	CW increases pulse width; ccw decreases pulse width.
20	FUNCTION	PULSE, then $\overline{\text{PULSE}}$.	Pulse direction reverses; dc levels remain the same values.
21	NORMAL/DOUBLE/ DELAYED Switch	DELAYED	– – –
22	PULSE DELAYED	10 μs ▮ 100 μs	– – –
23	PULSE DELAYED VARIABLE	Turn knob.	Pulse moves horizontally.
24	NORMAL/DOUBLE/ DELAYED Switch	DOUBLE	– – –
25	PULSE DELAYED VARIABLE	Turn knob to resolve two pulses.	– – –

SECTION 3
OPERATION

3.1 CONTROLS AND CONNECTIONS

The generator front panel controls and connectors are shown in figure 3-1 and keyed to the following descriptions.

(1) POWER Switch

Turns generator on and off.

(2) Frequency Dial

Settings under the dial index mark multiplied by (17) determine the output signal frequency. The dial calibration marks correspond to the frequency (black) numbers only. The period (grey) numbers are approximations only. Refer to table 3-1 for quick period/frequency conversion. The frequency can be varied by the vernier (17) and the VCG signal (16).

(3) GENERATOR MODE Switch

Selects one of the following three modes.

CONT – Continuous output at FUNCTION OUT, SYNC OUT and, if PULSE WIDTH is on, PULSE OUT connectors.

TRIG – DC level output at all six output connectors until the generator is triggered by MANUAL TRIGGER switch or with a signal at the TRIG IN connector. When triggered, the generator output is one cycle of waveform or one pulse period followed by a dc level.

GATE – As for TRIG except the output is continuous for the duration of the trigger signal at TRIG IN. The last cycle or period started is completed.

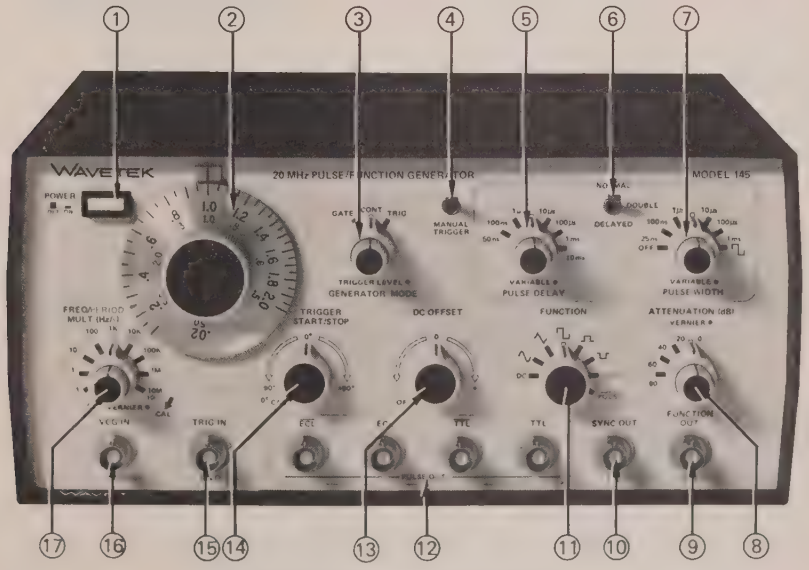


Figure 3-1. Controls and Connectors

Table 3-1. Period to Frequency Conversion

Converted Frequency Dial Values
(Based on f = 1/T where ⌜⌟)
←T→

Time	Freq	Time	Freq	Time	Freq
.5	2	2.3	.44	4.1	.24
.6	1.67	2.4	.42	4.2	.24
.7	1.43	2.5	.4	4.3	.23
.8	1.25	2.6	.39	4.4	.23
.9	1.11	2.7	.37	4.5	.22
1	1	2.8	.36	4.6	.22
1.1	.91	2.9	.35	4.7	.21
1.2	.83	3	.33	4.8	.21
1.3	.77	3.1	.32	4.9	.2
1.4	.71	3.2	.31	5	.2
1.5	.67	3.3	.3		
1.6	.63	3.4	.29		
1.7	.59	3.5	.29		
1.8	.56	3.6	.28		
1.9	.53	3.7	.27		
2	.5	3.8	.26		
2.1	.48	3.9	.26		
2.2	.46	4	.25		

Symbols
M = 10^6
k = 10^3
m = 10^{-3}
μ = 10^{-6}
n = 10^{-9}

To use the dial calibration marks when setting period time, the period must be converted to frequency.

Example: Set generator for a 23 μs pulse period.

1. Find the number 23 (or .23, 2.3, etc.) in the Time column. Note its form and Freq equivalent.

Time	Freq
2.3	.44

2. Express 23 μs using the 2.3 form: 2.3 X 10^{-5}.

3. Set FREQ/PERIOD MULT switch to the equivalent of 10^{-5}: 10μ.

4. Set the dial to the frequency equivalent of 2.3: .44.

NOTE: Refer to paragraph 1.2 for dial accuracy.

TRIGGER LEVEL Control

Determines the level at which the input trigger signal at the TRIG IN connector (15) is accepted as a trigger or gate in the trigger and gate modes. The trigger level can be varied from fully cw, where a positive-going excursion thru approximately −10V is a trigger, to fully ccw, where a positive-going excursion thru approximately +10V level is a trigger.

(4) MANUAL TRIGGER Switch

Triggers or gates the output signal when GENERATOR MODE switch (3) is at TRIG or GATE. In trigger mode, one cycle is output when the switch is pressed. In gate mode, cycles are continuously output as long as the switch is held down.

NOTE
Set TRIGGER LEVEL (3) fully ccw.

(5) PULSE DELAY Control

When NORMAL/DOUBLE/DELAYED switch (6) is at DELAYED, PULSE DELAY selects one of six time ranges for delay of pulse with respect to the undelayed signal leading edge. When (6) is at DOUBLE, PULSE DELAY selects the time between double pulse leading edges.

VARIABLE Control

Inner knob selects delay time within the range selected by the outer knob.

(6) NORMAL/DOUBLE/DELAYED Switch

Selects the pulse parameters as follows:

NORMAL – Pulse of width and frequency set by front panel switches appears at TTL, $\overline{\text{TTL}}$, ECL,

$\overline{\text{ECL}}$ and FUNCTION OUT connectors with synchronous leading edges to the sync pulse (10) trailing edge.

DOUBLE – As NORMAL plus an additional pulse in each pulse period delayed from the first pulse leading edge by time (5).

DELAYED – As NORMAL, except the pulse leading edge is delayed from the normal pulse leading edge by time (5).

(7) **PULSE WIDTH Control**

Outer knob selects the range for the width of all pulses except sync. Has OFF and square wave detents. When in OFF position, the 145 has no PULSE OUT outputs. The square wave (⊓⊔) detent is normally used to check the 50% period point; PULSE DELAY (5) has no effect. For the best square wave output, set FUNCTION (11) to ⊓⊔ .

VARIABLE Control

Inner knob selects pulse width within the range selected by the outer knob.

(8) **ATTENUATION Control**

Outer knob reduces output voltage level of all outputs at FUNCTION OUT with increasing steps of attenuation.

VERNIER Control

Inner knob is a 20 dB vernier which controls the output within the steps of the outer knob. DC and offset voltages are not affected by this control.

(9) **FUNCTION OUT Connector**

The only output for the functions other than fixed amplitude pulse. At this output the functions and pulses are controllable in amplitude and dc offset; the other outputs furnish fixed amplitude pulses only.

(10) **SYNC OUT Connector**

Furnishes a TTL pulse for each cycle or period of the generator. To be used for scope or similar synchronization. Refer to paragraph 3.2.1.4 for conversion to an ECL sync pulse.

(11) **FUNCTION Switch**

Selects one of eight output signals: dc, waveforms or pulses.

(12) **PULSE OUT**

Four standard pulses for logic circuits as follows (PULSE WIDTH (7) must be other than OFF):

TTL Connector – Furnishes a transistor-transistor-logic level pulse whose occurence and duration are controllable. Levels are typically < 0.5V quiescent, > 2.0V active into a 50Ω termination.

$\overline{\text{TTL}}$ Connector – Same as TTL connector except active and quiescent levels are reversed.

ECL Connector – Furnishes an emitter-coupled logic level pulse with controllable occurence and duration. Levels are typically –1.8V quiescent, –0.9V active into a 50Ω termination connected to –2 volts. Refer to paragraph 3.2.1.3 for ECL loading instructions.

$\overline{\text{ECL}}$ Connector – Furnishes an output like the ECL output, except active and quiescent levels are reversed.

(13) **DC OFFSET Control**

Offsets the waveform or dc level at (9) from –15V to +15V (open circuit; ±7.5V into 50Ω). An OFF position ensures no offset.

(14) **TRIGGER START/STOP Control**

Sets the start and stop point of the selected waveform (sine or triangle only) appearing at (9). Usually used in the trigger mode and in combination with (13) to create desired waveforms. 0° CAL position ensures conventional waveforms symmetrical about 0 Vdc.

(15) **TRIG IN Connector**

Accepts a 1V p-p to 10V external signal to trigger the generator. (Up to ±50V will not damage circuitry.) Triggers on rising edge of input which crosses TRIGGER LEVEL (3) setting from negative to positive.

(16) **VCG IN Connector**

Accepts 0 to +2V ac or dc voltages to vary up to 1000:1 the frequency and period of the outputs.

The upper and lower limits are defined by the maximum and minimum dial (2) settings multiplied by (17) . VCG input will not drive the generator beyond the normal dial limits of a range.

(17) FREQ/PERIOD MULT Switch

The outer knob selects one of ten frequency/period multipliers for the dial (2) setting. Frequency, then period, are noted at each setting.

VERNIER Control

A fine adjustment of the frequency dial (2) setting.

Not Shown EXT DC OFFSET IN Connector (Rear Panel)

Applied voltage offsets the selected waveform linearly. Offset is 1V for each −1V applied with output connected into an open circuit. Maximum input is ±7.5V. Offset is affected by the attenuator (8)

Not Shown GCV OUT Connector (Rear Panel)

This connector gives a 0 to +2V signal proportional to the frequency of the generator within any given range. The signal can be used as the X drive for X-Y recorders.

3.2 OPERATION

Perform the initial checkout in Section 2 for the feel of the instrument. Any questions concerning individual controls and connectors may be answered in paragraph 3.1.

3.2.1 Signal Termination

3.2.1.1 FUNCTION OUT Signal

Proper signal termination, or loading, of the generator connectors is necessary for its specified operation. For example, the proper termination of the main output is shown in figure 3-2. Placing the 50Ω terminator, or 50Ω resistance, in parallel with a higher impedance matches the receiving instrument input impedance to the generator output impedance, thereby minimizing signal reflection or power loss on the line due to phase angle mismatch.

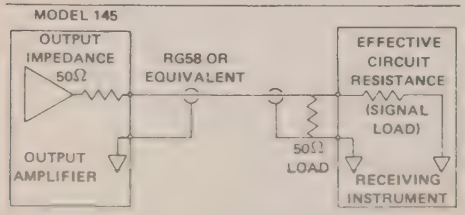


Figure 3-2. Signal Termination

3.2.1.2 TTL PULSE OUT Signals

The TTL and $\overline{\text{TTL}}$ PULSE OUT outputs can drive 50Ω and higher impedance terminations.

3.2.1.3 ECL PULSE OUT Signals

The ECL and $\overline{\text{ECL}}$ PULSE OUT outputs are driven by MC10124's. The signals must be properly terminated at the point that they enter an external ECL circuit. Several connection possibilities are shown in figure 3-3.

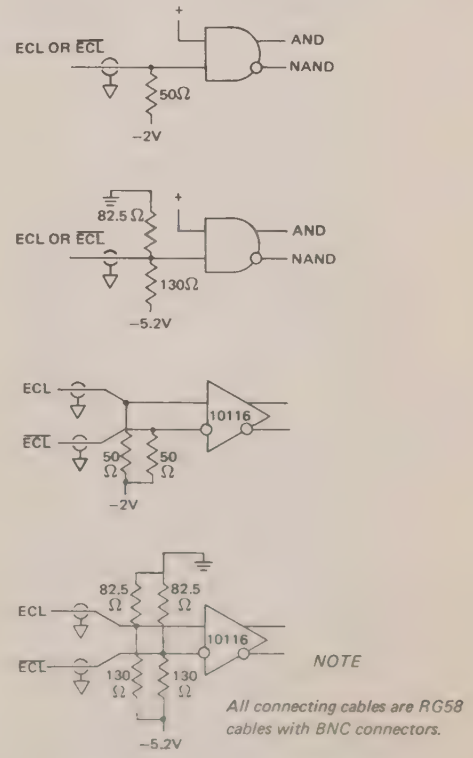


Figure 3-3. ECL Terminations

3.2.1.4 Conversion of SYNC OUT TTL to ECL

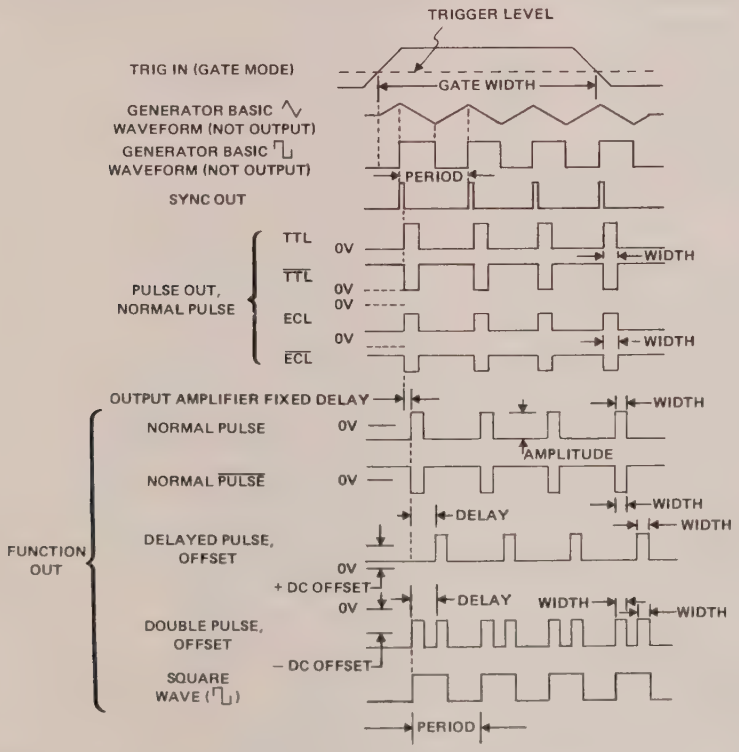
The SYNC OUT TTL pulse can be converted to an ECL pulse by rerouting two jumpers on the trigger/pulse printed circuit board. Disconnect jumper at E24 and connect to E25. Disconnect jumper at E27 and connect to E28. The two jumpers are correctly routed from E25 to E26 and from E28 to E29 for ECL operation. Instrument disassembly is covered in paragraph 5.3.

3.2.2 Pulses

See figure 3-4 for definition of controllable pulse characteristics.

3.2.3 Waveforms

See figure 3-5 for definition of controllable waveform characteristics.



NOTES

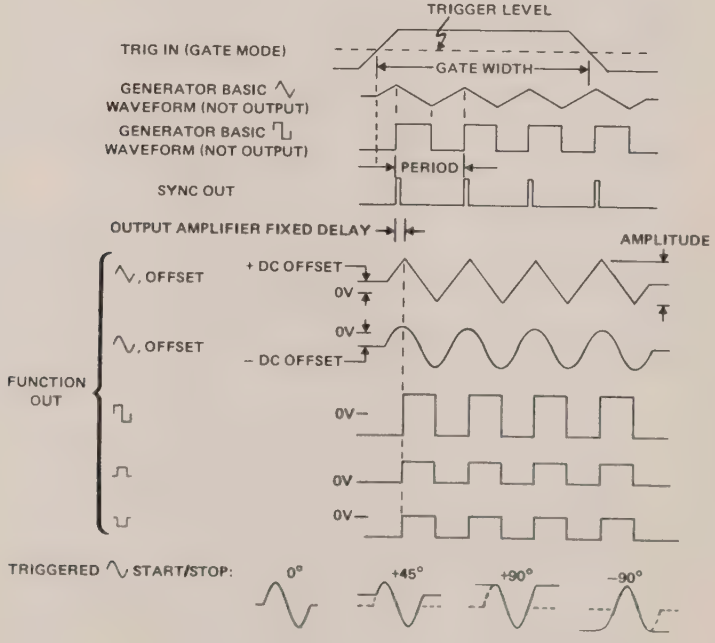
1. *Not Shown: TTL, $\overline{TTL}$, ECL, $\overline{ECL}$ double pulse, delayed pulse and $\overline{pulse}$.*
2. *Pulse period is determined by the generator frequency setting unless in trigger mode, in which case it is determined by trigger frequency.*
3. *In trigger mode, just one period is generated for each trigger pulse.*
4. *DC offset plus pulse peak voltage > | 7.5V | causes pulse clipping.*

Figure 3-4. Pulse Characteristics

3.2.4 Voltage Controlled Function Generator Operation

Operation as a voltage controlled function generator (VCG) is as for a manually controlled function generator, only the frequency within particular ranges is additionally controlled with dc levels (±2V excursions) injected at the VCG IN connector. Set the frequency dial to a reference from which the frequency is to be voltage controlled.

1. For frequency control with positive dc inputs at VCG IN, set the dial for a lower frequency limit.
2. For frequency control with negative dc inputs at VCG IN, set the dial for an upper frequency limit.
3. For modulation with an ac input at VCG IN, set dial at desired center frequency. Do not exceed the maximum dial range of the selected frequency range.



NOTES

1. *Period is controlled by the generator frequency setting.*
2. *In trigger mode, just one period is generated for each trigger pulse.*
3. *DC offset plus peak waveform voltage > | 7.5V | causes waveform clipping.*

Figure 3-5. Waveform Characteristics

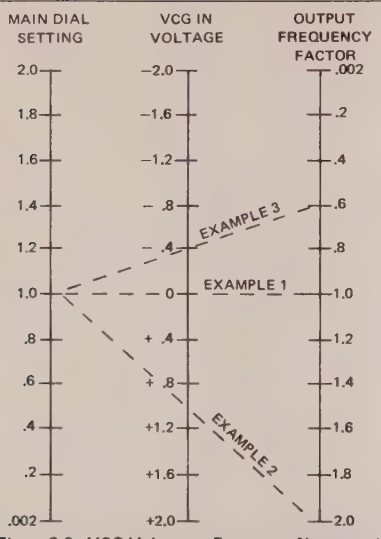


Figure 3-6. VCG Voltage-to-Frequency Nomograph

Figure 3-6 is a nomograph with examples of dial and voltage effects. Example 1 shows that with 0V VCG input, frequency is as determined by the main dial setting, 1.0 in this example. Example 2 shows that with a positive VCG input, output frequency is increased. Example 3 shows that with a negative VCG input, output frequency is decreased. (Note that the Output Frequency Factor column value must be multiplied by a frequency range multiplier to give the actual output frequency.)

NOTE

The frequency vernier must be rotated fully ccw for 1000:1 range.

Nonlinear operation results when the VCG input voltage is excessive; that is, when the attempted generator frequency exceeds the range setting (2 times the multiplier setting) or in the other direction, 1/1000th of the range setting.

The up to 1000:1 VCG sweep of the generator frequencies available in each range results from a 2V excursion at the VCG IN connector. With the frequency dial set to 2.0, excursions between −2V and 0V at VCG IN provide the up to 1000:1 frequency sweep. With the dial set to .002, excursions between 0V and +2V at VCG IN provide the up to 1000:1 sweep within the set frequency range.

3.2.5 Delay of Triggered Pulse

Additional pulse delay is available in triggered mode. Not only is the PULSE DELAY usable, but the ¼ cycle delay between trigger acceptance and sync pulse shown in figure 3-7 can also be variable delay.

Merely determine the delay desired and apply this formula for the frequency setting:

$$\text{Frequency in Hz} = \frac{1}{(4 \cdot \text{delay in seconds})}$$

Then, adjust the pulse width for your desired pulse. Practical range with the frequency dial and multiplier is 1 ms to 42 minutes. Delay control range is 50 ns to 10 ms.

Frequency vernier and start/stop control also affect the delay. So, for accurate frequency dial control of delay, set these at their cal positions.

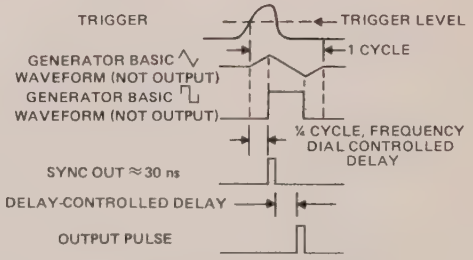


Figure 3-7. Pulse Delay From Trigger

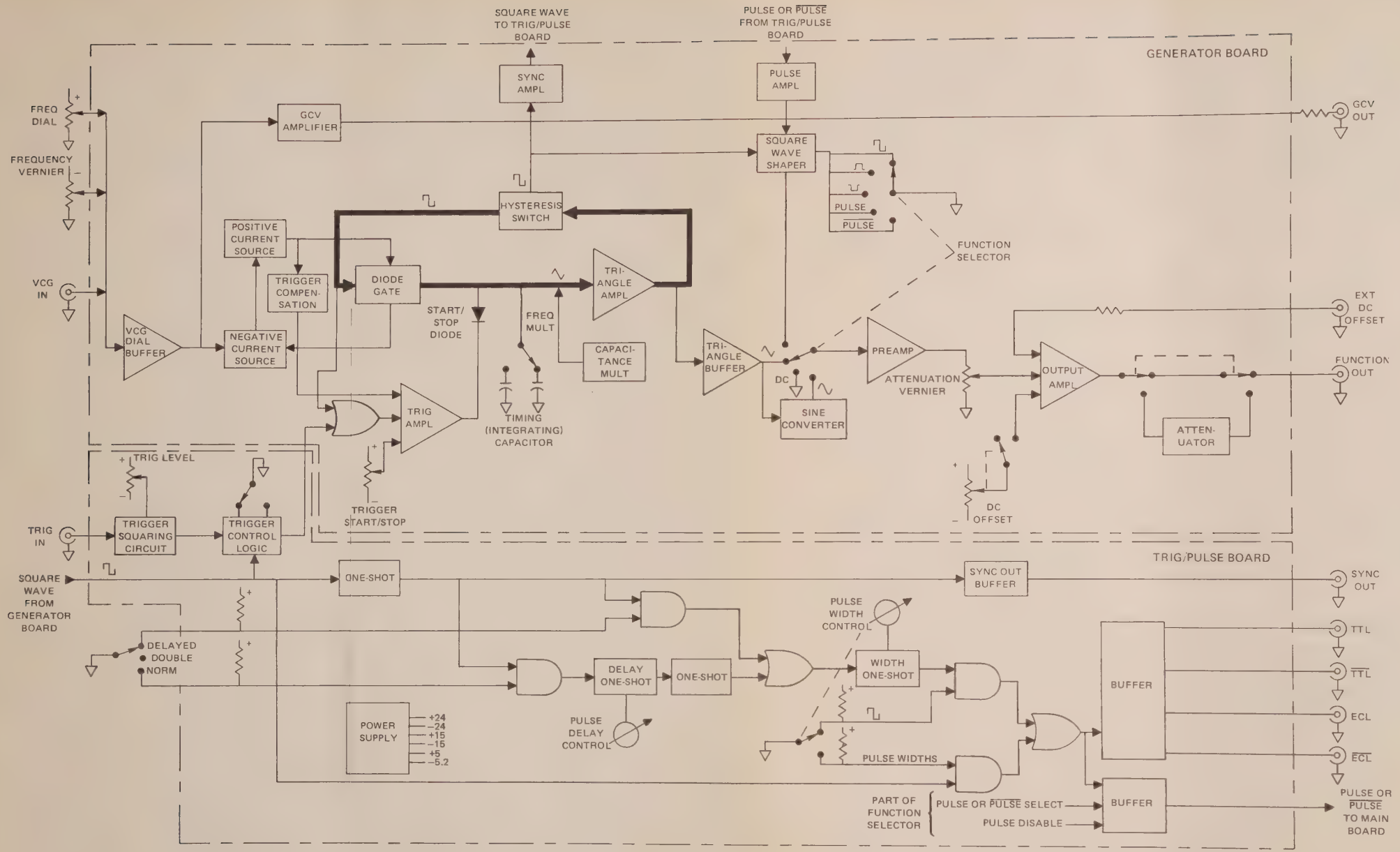


Figure 4-1. Overall Block Diagram

SECTION 4
CIRCUIT DESCRIPTION

4.1 BASIC WAVEFORM DEVELOPMENT

The heart of the generator (the bold path in figure 4-1) is a triangle and square wave generator. The triangle waves are developed by capacitor charging ramps that are alternately reversed in polarity. The polarity reversal is caused by a flip-flop circuit, or hysteresis switch, that in turn produces the square waves. The flip-flop changes states upon detecting amplitude limits of the charging ramps through the triangle amplifier.

As shown in figure 4-1, the VCG dial buffer sums the currents from the frequency dial, frequency vernier and VCG in connector. The VCG dial buffer is an inverting amplifier whose output voltage is used to control a positive current source and a negative current source. For symmetrical output waveforms, the currents from the two current sources are equal and directly proportional to the voltage of the VCG dial buffer output. The diode gate, which is controlled by the hysteresis switch, is used to switch the positive or the negative current to the integrating capacitor selected by the frequency multiplier. If the positive current is switched into the integrating capacitor, the voltage across the capacitor will rise linearly to generate the triangle rise transition. If the current is negative, the voltage across the integrating capacitor will fall linearly to produce the fall transition.

The triangle amplifier is a unity gain amplifier whose output is fed to the hysteresis switch. The hysteresis switch has two voltage limit points (+1.25 and −1.25V) at its input.

During the time the output voltage of the triangle amplifier is rising, the output voltage of the hysteresis switch is positive, but when the output voltage of the triangle reaches +1.25V, it triggers the hysteresis switch causing the output to switch negative. Once the control voltage into the diode gate becomes negative, it will switch the positive current out and switch the negative current in to the integrating capacitor, so that the voltage across the capacitor will reverse, starting a linear decrease of the waveform. When the decreasing voltage reaches −1.25V, the output of the hysteresis switch will switch back to positive, reversing the process. This action generates the triangle waveform as shown in figure 4-2. Since the output of the hysteresis switch is a square wave, the result is simultaneous generation of a square wave and a triangle wave at the same frequency.

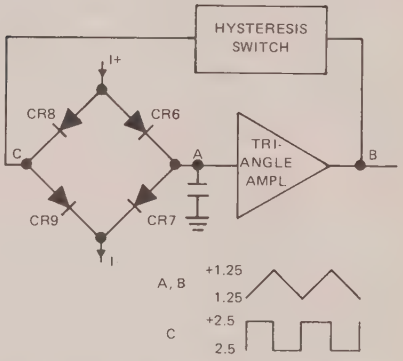


Figure 4-2. Basic Generator and Timing Diagram

The output frequency is determined by the magnitude of the capacitor selected by the frequency multiplier and the magnitude of the positive and negative current sources. Since the current sources are linearly proportional to the control voltage of the VCG circuit, the output frequency will also be linearly proportional to the control voltage.

The output of the hysteresis switch is fed to the sync amplifier and also the square wave shaper. The square wave shaper consists of a shaping circuit which limits the square wave output swing to ±1.25V. For positive pulse outputs, it limits the output voltage swing from −1.25 to 0V; and for negative pulse outputs, it limits the output swing from 0 to +1.25V. The PULSE or $\overline{\text{PULSE}}$ from the auxiliary board are bipolar and processed as the square wave.

The triangle wave from the triangle amplifier is coupled through a buffer amplifier and made available to the function selector switch. The buffer amplifier provides a low impedance to drive the sine converter circuit. The sine converter, using the nonlinear characteristics of its diodes, converts the triangle wave into a sine wave.

The square wave from the sync amplifier, processed through a one-shot and the sync out buffer, is externally available at the sync out connector. The sync pulse, then, is a TTL level pulse output of the generator frequency.

4.2 AMPLITUDE OFFSET AND ATTENUATION

The selected waveform is inverted and amplified in the preamplifier. The preamplified waveform is sent to the output amplifier.

The output amplifier is an inverting amplifier with a current limiting output stage for short circuit protection. The dc offset control provides the offset to the selected waveforms center reference. The dc offset can be set by voltage at the external dc offset connector. The output amplifier establishes the generator 0 dB attenuation reference. An output attenuator decreases this reference amplitude in operator selected 20 dB steps. The attenuator consists of three voltage dividers. Attenuation between the steps is provided by the attenuation vernier.

4.3 TRIGGER AND GATE CONTROL

Generator operation is controlled by allowing or preventing the timing capacitor to charge. Figure 4-3 shows in detail this portion of the circuit. For continuous operation, the trigger amplifier maintains a positive level above the positive peak developed by the charging capacitors. This reverse biases (turns off) the start/stop diode, and the trigger amplifier does not interfere with continuous operation.

When the trigger amplifier outputs some level below the positive peak charging level, the diode is forward biased (turned on) to sink the integrating current from the current source, preventing the capacitors from charging to the positive peak. This stops waveform generation and holds the triangle output at some dc level called the trigger baseline. The trigger baseline is the level where a triangle waveform cycle starts and where it stops. This baseline is directly applicable to the triangle waveform and thus affects the sine wave. The square wave levels, output via the hysteresis switch, are not affected by the triangle baseline levels.

The normal trigger baseline is zero volts, analogous to 0° phase of a sine or triangle waveform. The trigger start/stop control offsets the trigger amplifier output and can change the baseline for starting and stopping a sine or triangle waveform from its negative peak (−90°) to its positive peak (+90°) range. At the extreme positive peak level setting though, the diode is again reverse biased and generator operation goes continuous.

When charging level is being held, the positive current generator still varies its output with corresponding frequency control inputs. These varying currents must be sunk through the diode to keep the timing capacitors from varying their charge, and thus varying the trigger baseline. The baseline compensation circuit monitors the output from the positive current generator to control the trigger amplifier and thus control the necessary compensating current through the diode.

The trigger control logic determines that after a waveform starts, it always stops at a complete cycle and at the same phase at which it started. The trigger control logic latches the trigger amplifier for an enabling output from the time the cycle starts to when the negative peak of the last cycle is reached (just one cycle in the trigger mode). Upon reaching the negative peak, the timing capacitor continues charging positive again, but stops upon reaching the trigger baseline. A square wave from the hysteresis switch synchronizes the last negative peak time for unlatching the trigger amplifier for its trigger baseline output.

The generator mode control circuitry (not shown) determines whether the trigger control logic is to be fired for just one cycle, or is to be held on for the duration of the trigger input. When in gate mode, the trigger is directly coupled for controlling the trigger control logic. In the trigger mode, the squaring circuit output is converted by a one-shot to a narrow pulse which fires the trigger control logic.

The squaring circuit is a level detector that generates a square pulse for the duration of a trigger signal above the set trigger level. The pulse is also generated for the duration the manual trigger switch is held down in gate mode, and fires one cycle in triggered mode.

4.4 PULSE OUTPUTS

The pulse outputs are based on the square wave from the basic generator circuit (see figure 4-1); the pulse frequency is controlled by the frequency dial, frequency vernier and VCG voltage in the same manner as the waveforms. The square wave is first modified to the sync pulse by a one-shot circuit; then the normal/double/delayed pulse selector switch sets or inhibits AND gates to distribute the sync pulse to the delay one-shot and the width one-shot circuits. When the switch is in normal position, the sync pulse is gated to the width one-shot; the delay one-shot is bypassed. When the switch is in delayed position, the sync pulse is gated to the delay one-shot only. With the switch in the double position, the sync pulse is gated to both the delay and width one-shots.

Pulse width of the width and delay one-shot pulses can be varied by the front panel width and delay controls, respectively. The resulting pulse is gated by the selection of a pulse width value rather than the square wave (⊓⊔) detent on the pulse width switch. The pulse or the basic generator square wave, as selected by the pulse width control, is sent to a buffer circuit and output as TTL, $\overline{\text{TTL}}$, ECL and $\overline{\text{ECL}}$ pulses. The pulse or square wave is also routed to another buffer which is set by the selection of PULSE, $\overline{\text{PULSE}}$ or a

waveform with the front panel function switch. This output, a normal pulse or a complemented pulse, is routed to the square wave shaper and output, if selected, through the output amplifier as a variable amplitude pulse. The pulse modes of normal, delayed and double are shown as timing diagrams in figures 4-4, 4-5 and 4-6.

4.5 WIDTH AND DELAY ONE-SHOTS

The pulse width and delay one-shots feature front panel adjustable current sources to regulate the capacitor charge time and as a result, the one-shot pulse width. The steady state condition of the one-shot circuit is as shown in figure 4-7: Upon triggering, $\overline{Q}$ goes low, the switch transistor switches off and the capacitor begins to charge. When the voltage across the capacitor is sufficient, the level detector senses the set level, the flip-flop is cleared and the circuit reverts to its steady state condition. The duty cycle of the one-shots is limited by the capacitor discharge time when returning to steady state conditions.

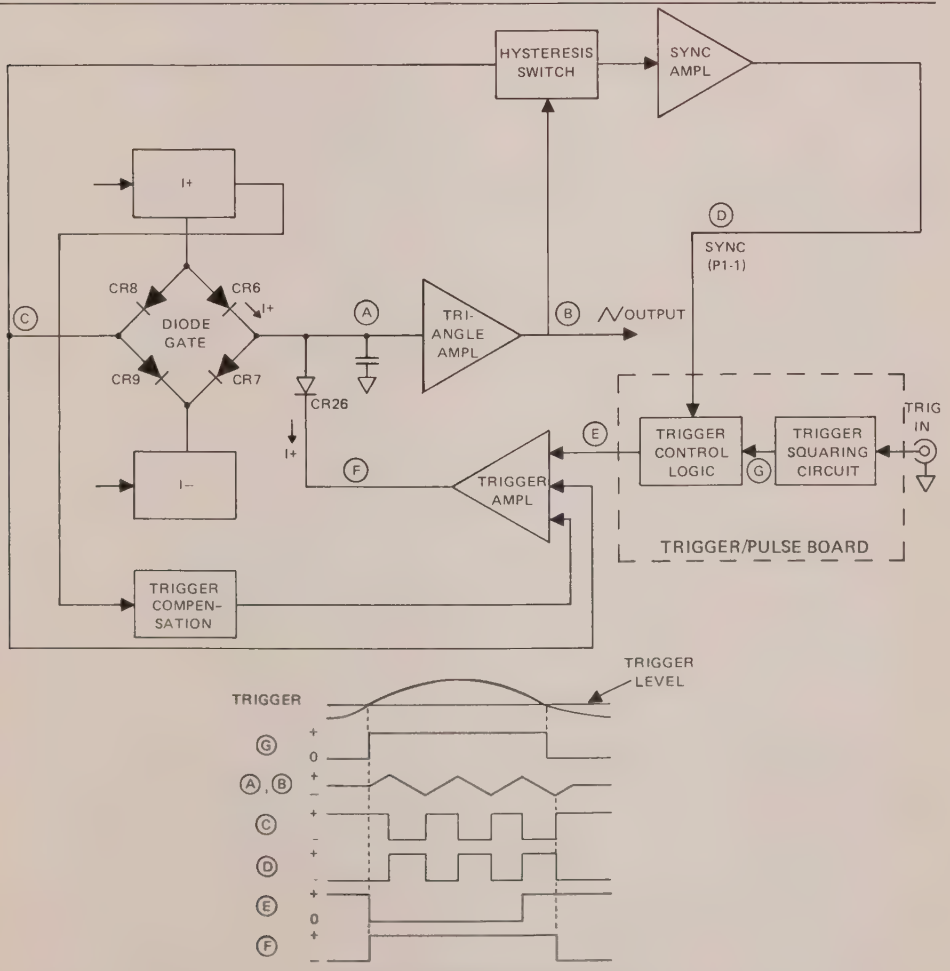


Figure 4-3. Trigger Circuit and Timing

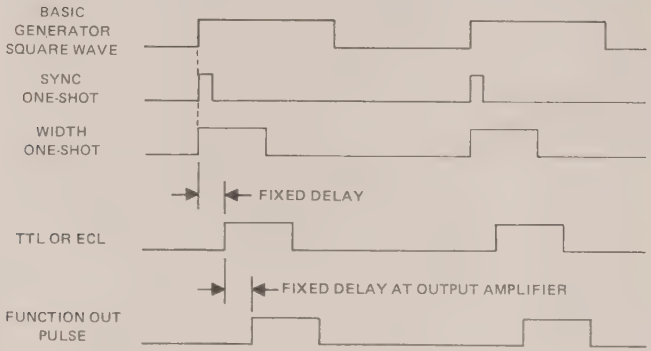


Figure 4-4. Normal Mode Timing

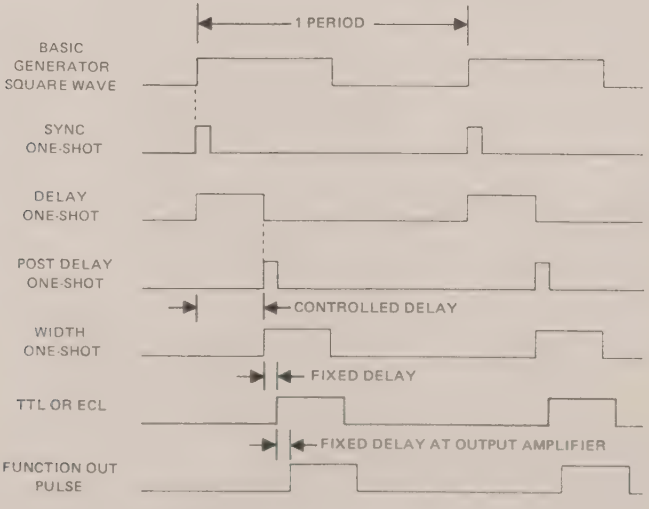


Figure 4-5. Delayed Mode Timing

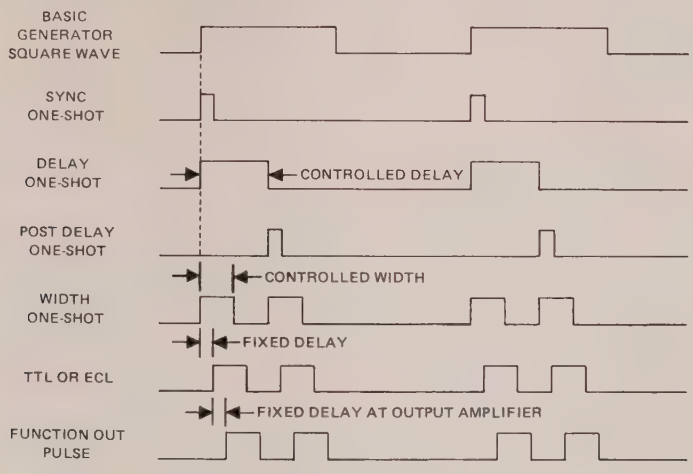


Figure 4-6. Double Mode Timing

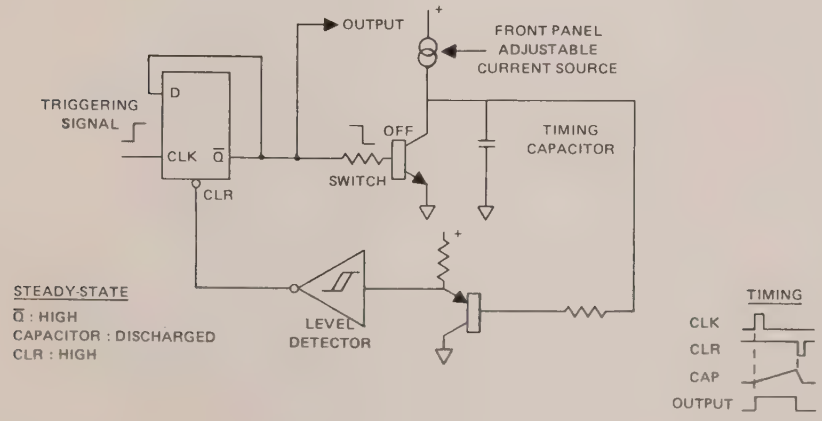


Figure 4-7. Width and Delay One-Shots

SECTION 5
CALIBRATION

5.1 FACTORY REPAIR

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

5.2 REQUIRED TEST EQUIPMENT

Voltmeter . . . . . 0.1 mVdc resolution (0.1% accuracy)
Oscilloscope, Dual Channel . . . . . ⩾ 150 MHz bandwidth
Distortion Analyzer . . . . . To 600 kHz
Counter . . . . . To 20 MHz (0.1% accuracy)
50Ω Load . . . . . ±0.1% accuracy, 2W
Generator . . . . . 200 kHz signal, 2 to 20V p-p

5.3 REMOVING GENERATOR COVERS

1. Invert the instrument, remove the four screws in the cover.

2. Turn the instrument upright, remove the top cover, and remove the four screws securing the bottom cover.

3. Replace the top cover and turn the instrument upside down.

NOTE

Remove the bottom cover only when it is necessary to make adjustments or measurements.

5.4 CALIBRATION

After referring to the following preliminary data, perform calibration, as necessary, per table 5-1. If performing partial calibration, check previous settings and adjustments for applicability. See figures 5-1 and 5-2 for calibration point location.

1. Unless otherwise noted, all measurements made at the 50Ω OUT connector should be terminated into a 50Ω (±0.1%) load.

2. Allow the unit to warm up at least 30 minutes for final calibration. Keep the instrument covers on to maintain heat. Remove covers only to make adjustments or measurements.

3. Verify operation in TRIG and GATE modes by connecting an external generator to the TRIG IN BNC and observing proper operation of TRIGGER LEVEL and TRIGGER START/STOP controls (paragraph 3.1).

4. Verify SYNC OUT is an approximate 30 ns positive pulse into 50Ω and that GCV OUT is a voltage proportional to dial position with a 2V max (open circuit).

5. Properly terminate the TTL, $\overline{\text{TTL}}$, ECL and $\overline{\text{ECL}}$ outputs (paragraph 3.2.1) and verify proper operation (paragraph 3.1).

6. Start the calibration by connecting the unit to an ac source and setting the front panel switches as follows:

Dial 02
FREQ MULT 100K
FREQ VERNIER . . . . . Full cw
GENERATOR MODE . . . . . CONT
TRIGGER LEVEL . . . . . Full ccw
TRIGGER START/STOP . . . . . 0° CAL
PULSE DELAY . . . . . 50 ns ❙ 100 ns
PULSE DELAY VARIABLE . . . . . cw
Pulse Mode . . . . . DOUBLE
PULSE WIDTH . . . . . OFF
PULSE WIDTH VARIABLE . . . . . 12 o'clock
DC OFFSET . . . . . OFF
FUNCTION . . . . . DC
ATTENUATION . . . . . 20 ❙ 0
ATTENUATION VERNIER . . . . . Full ccw
POWER . . . . . ON

Table 5-1. Calibration Chart

Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
1	Power Supply	DVM	C111			+15 ±0.05 Vdc	If voltage is incorrect, proceed to step 3.
2			C112			−15 ±0.05 Vdc	If voltage is correct, proceed to step 9.

Steps 3 - 8 are on the trig/pulse board. Place the cover on the generator and turn it upright. Remove the top cover for access to the trig/pulse board.

3	Power Supply	DVM	TP1 (COM) TP2 (±15 Vdc)		R27	+15 ±0.02 Vdc	
4			TP3			−15 ±0.05 Vdc	
5			TP4			+24 ±1 Vdc	
6			TP5			−24 ±1 Vdc	
7			TP6			+5 ±0.2 Vdc	
8			TP7		R18	−5.2 ±0.01 Vdc	

If steps 3 - 8 were performed, place the cover on, invert the generator and warm up the generator for ½ hour. Remove the uppermost cover for generator board access when necessary.

9	Cap Mult Balance	DVM (DCV)	TP5 (COM) TP1		R55	< 5 mV	
10	Power Ampl Balance		FUNC-TION OUT		R181	0 ±0.01 Vdc	Terminate with 50Ω load.
11	Preamp Balance			ATTENUATION VERNIER: full cw	R252	0 ±0.01 Vdc	
12	VCG Null	Scope		FUNCTION: ⊓⊔	R12	Minimum frequency shift	Observe one cycle at 50μs/div. Alternately short and open VCG IN BNC while adjusting R12.
13	1000:1 Freq			FREQ VERNIER: full ccw	R13 BOD Freq Adj	< 1 cycle (< 200 Hz)	Scope on .5 ms/div.

Table 5-1. Calibration Chart (Continued)

Step	Check	Tester	Cal Points	Control Settings	Adjust	Desired Results	Remarks
14	1000:1 Symmetry	Scope	FUNCTION OUT		R16 BOD Sym	Symmetrical waveform	*NOTE: Steps 13 and 14 are interactive.*
15	Main Symmetry			FREQ VERNIER: full cw Dial: 2.0 FREQ MULT: 1K	R35 TOD Sym	Symmetrical waveform	
16	Sine Distortion	Distortion Analyzer, Scope		FUNCTION: ∿	R120 Triangle Balance	Symmetrical residue	Connect FUNCTION OUT to distortion analyzer and distortion analyzer output to scope. Set scope to .1V/div. Sync scope to SYNC OUT BNC loaded into 50Ω.
17					R93, R107 Triangle Peaks	Minimum sine distortion	If either adjustment is going near a stop, recenter both pots and return to step 15.
18	Main Freq	Frequency Counter/ Timer		FUNCTION: ⊓	R4 TOD Freq Adj	2000 ±10 Hz	Remove SYNC OUT cable.
19	Cap Mult Freq			FREQ MULT: 10	R48	20 ±0.1 Hz	
20	X 10M Freq			FREQ MULT: 10M Dial: Vary	C40	Best frequency tracking over X 10M range	
21	X 1M Freq			FREQ MULT: 1M Dial: Vary	C34	Best frequency tracking over X 1M range	This adjustment must be made each time step 20 is done.
22	Trigger Baseline	Scope		FUNCTION: ∿ GENERATOR MODE: TRIG Dial: Vary	R162	Minimum shift of baseline around 0 Vdc	

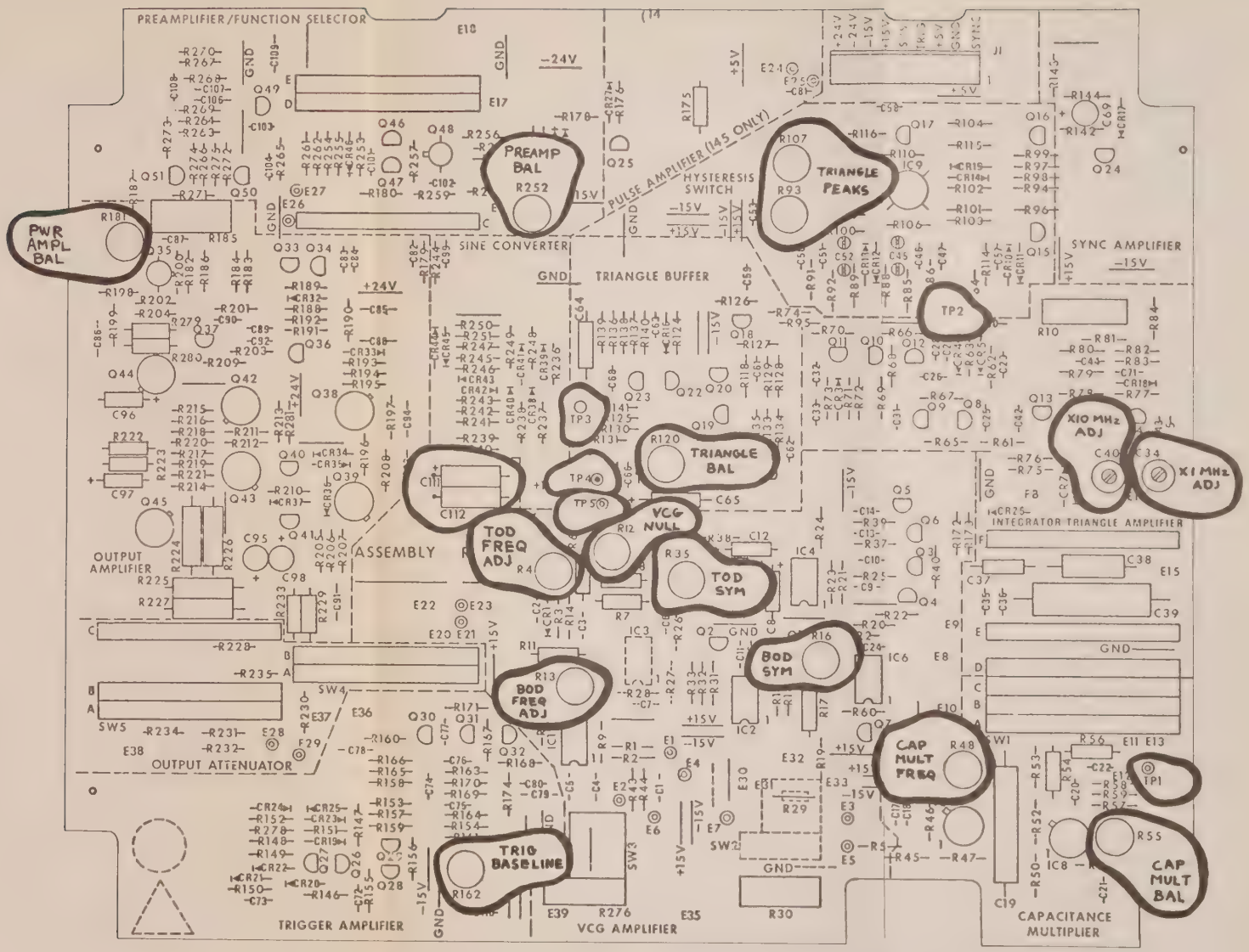


Figure 5-1. Generator Board

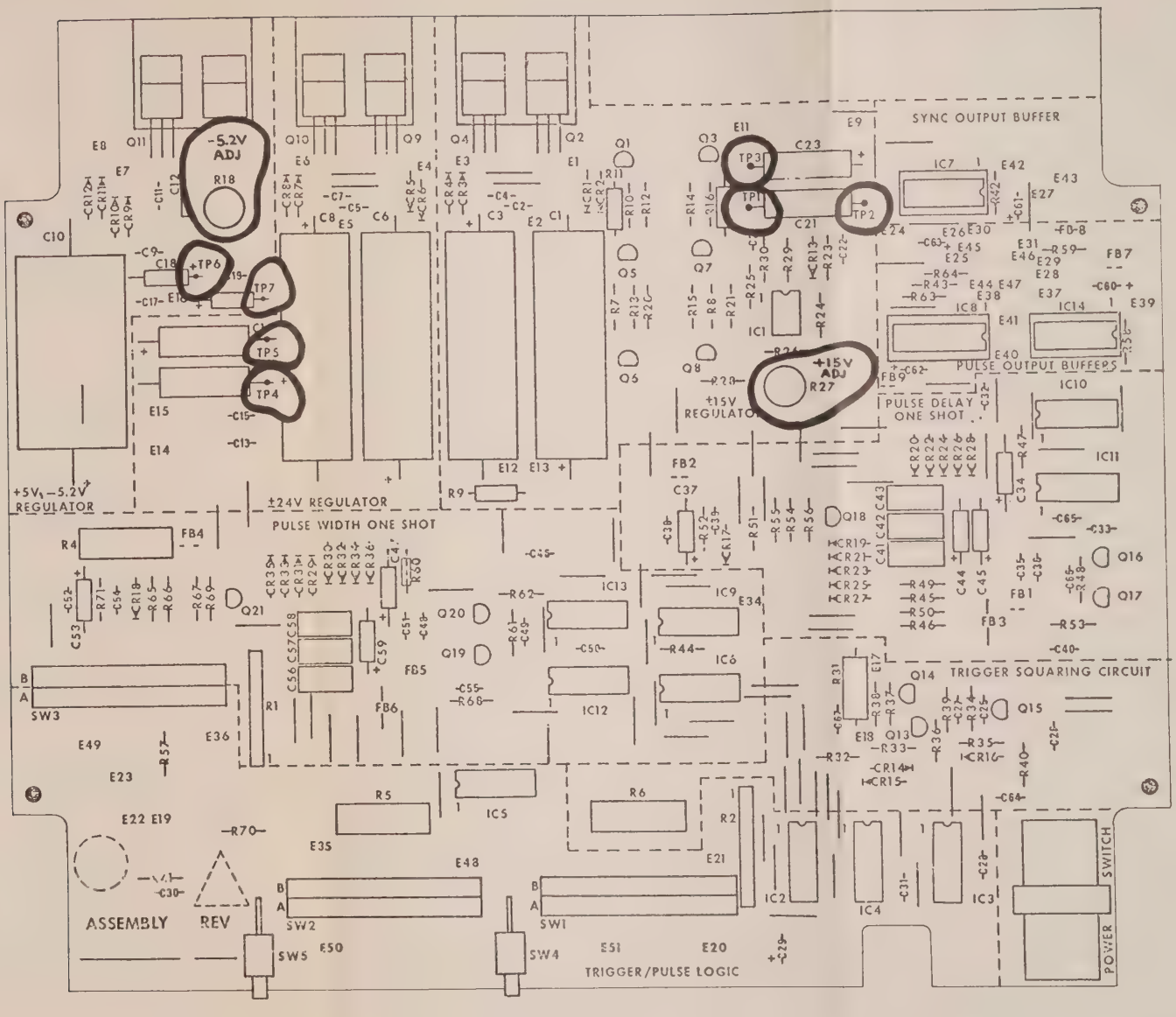


Figure 5-2. Trig/Pulse Board

SECTION 6
TROUBLESHOOTING

6.1 FACTORY REPAIR

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

6.2 TROUBLESHOOTING CHARTS

Troubleshooting charts are given in figures 6-1 thru 6-9. The charts do not cover every possible trouble, but will be an aid in systematically isolating faulty components.

Figure 6-1. Initial Checks, Generator Board
Figure 6-2. Generator Loop Checks, Generator Board
Figure 6-3. VCG Checks, Generator Board
Figure 6-4. Generator Output Checks
Figure 6-5. Trigger and Gate Mode Checks, Trig/Pulse Board
Figure 6-6. Power Supply Checks, Trig/Pulse Board
Figure 6-7. Generator Input and Output Checks
Figure 6-8. Pulse Mode Checks, Trig/Pulse Board
Figure 6-9. Pulse Generator Checks, Trig/Pulse Board

6.3 TROUBLESHOOTING INDIVIDUAL COMPONENTS

6.3.1 Transistor

1. A transistor is defective if more than one volt is measured across its base emitter junction in the forward direction.

2. A transistor when used as a switch may have a few volts reverse bias voltage across base-emitter junction.

3. If the collector and emitter voltages are the same, but the base emitter voltage is less than 500 mV forward voltage (or reversed bias), the transistor is defective.

4. A transistor is defective if its base current is larger than 10% of its emitter current (calculate currents from voltage across the base and emitter series resistors).

5. In a transistor differential pair (common emitter stages), either their base voltages are the same in normal operating condition, or the one with less forward voltage across its base emitter junction should be off (no collector current); otherwise, one of the transistors is defective.

6.3.2 Diode

1. A diode is defective if there is greater than one volt (typically 0.7 volt) forward voltage across it.

6.3.3 Operational Amplifier (e.g., 741, 1458)

1. The "+" and "–" inputs of an operational amplifier will have less than 15 mV voltage difference when operating under normal conditions.

2. When the output of the amplifier is connected to the "–" input (voltage follower connection), the output should be the same voltage as the "+" input voltage; otherwise, the operational amplifier is defective.

6.3.4 Capacitor

1. Shorted capacitors have zero volts across their terminals.

2. Opened capacitor can be located (but not always) by using a good capacitor connected in parallel with the capacitor under test and observing the resulting effect.

6.3.5 Digital TTL IC's (e.g. 7400 Series)

1. The device is operating correctly if the output high state is $>$ +2.4V and low state is $<$ +0.5V.

2. The input must show the same two levels as in step 1. If the levels are between +0.8V and +2.0V, the connection to the driving circuit output is open.

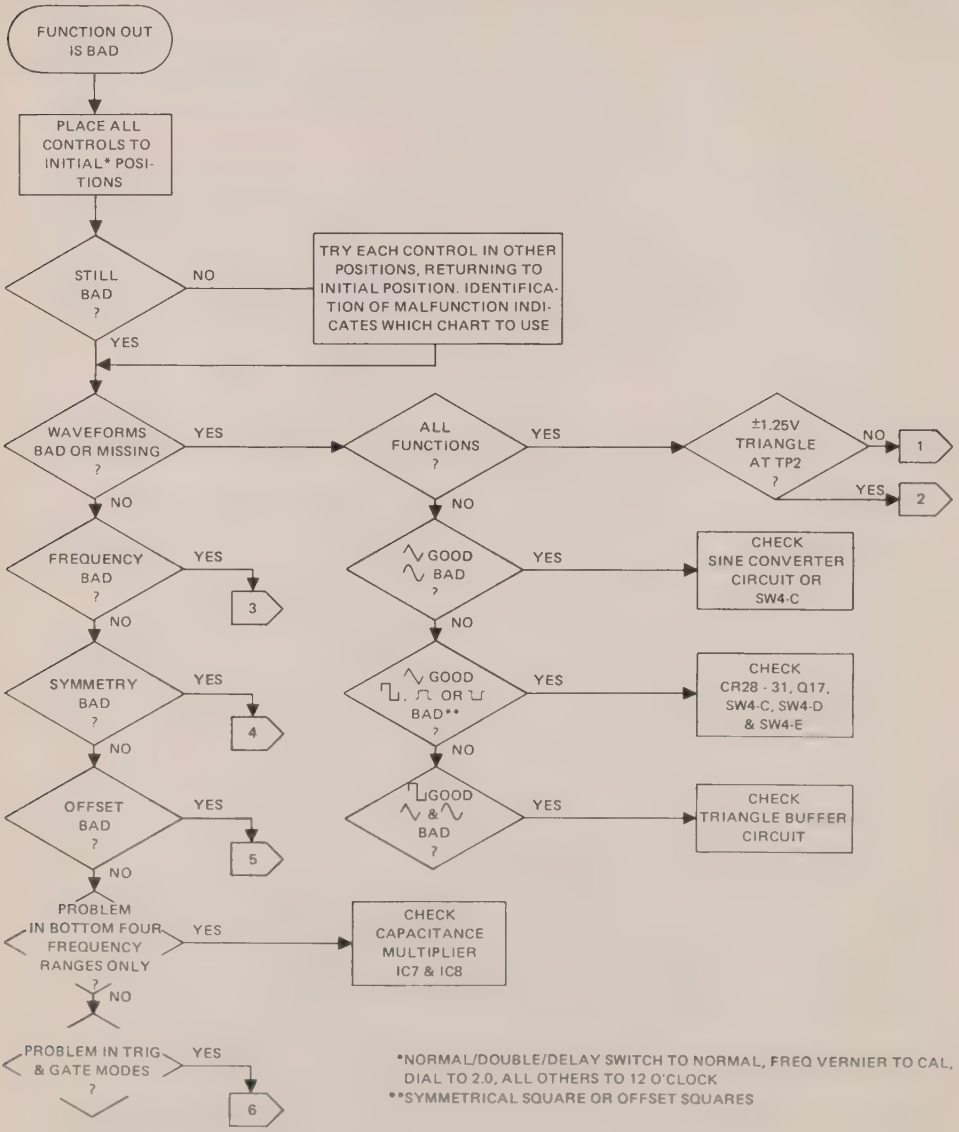
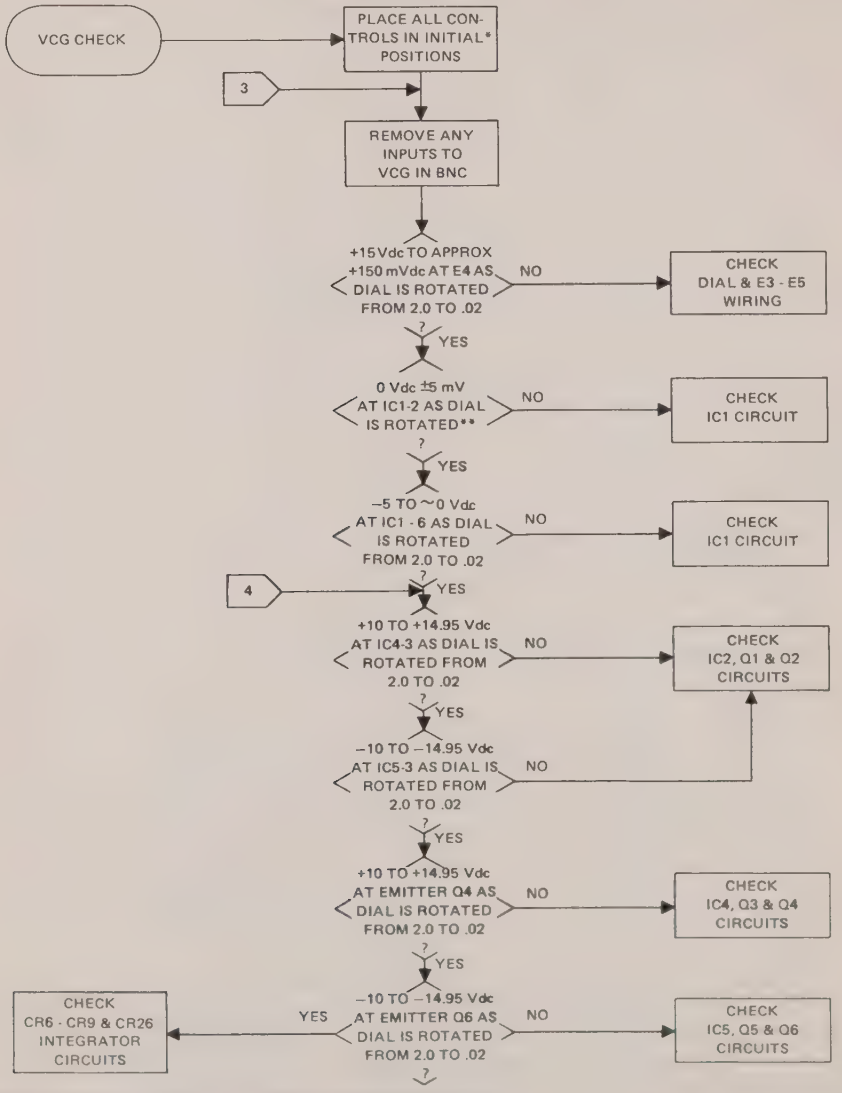


Figure 6-1. Initial Checks, Generator Board

GENERATOR LOOP
PLACE ALL CONTROLS IN INITIAL* POSITIONS
±1.25V 2 kHz TRIANGLE AT TP2 ?
YES
2
1
NO
P1-9 +24 Vdc
P1-8 −24 Vdc
P1-7 −15 Vdc
P1-6 +15 Vdc
?
NO
7
YES
+1.5 TO + 2.0 Vdc AT R172 & R173** ?
NO
6
YES
APPROX +10 Vdc AT Q4 & −10 Vdc AT Q6 EMITTERS
?
NO
3
YES
VOLTAGE AT WIPER SW1-F (GN WIRE) THE SAME AS AT TP2
?
NO
CHECK TRIANGLE AMPL Q8 - Q12 CIRCUIT
YES
APPROX 2 Vdc AT COLLECTOR Q15 & OPPOSITE IN POLARITY TO THAT AT TP2 ?
NO
CHECK HYSTERESIS SWITCH IC9 & Q15 - Q17 CIRCUIT
YES
VOLTAGE AT EMITTERS Q13 & Q14 THE SAME AS AT COLLECTOR Q15
?
NO
CHECK INTEGRATOR Q13 & Q14 CIRCUITS & DIODES CR6 - CR9 CR26
*NORMAL/DOUBLE/DELAY SWITCH TO NORMAL, FREQ VERNIER TO CAL, DIAL TO 2.0, ALL OTHERS TO 12 O'CLOCK
**A NEGATIVE VOLTAGE HERE STOPS GENERATOR FOR TRIGGERED OPERATION
***USE SCOPE AND HIGH IMPEDANCE PROBE

Figure 6-2. Generator Loop Checks, Generator Board


VCG CHECK
PLACE ALL CONTROLS IN INITIAL* POSITIONS
3
REMOVE ANY INPUTS TO VCG IN BNC
+15 Vdc TO APPROX +150 mVdc AT E4 AS DIAL IS ROTATED FROM 2.0 TO .02
NO
CHECK DIAL & E3 - E5 WIRING
YES
0 Vdc ±5 mV AT IC1-2 AS DIAL IS ROTATED**
NO
CHECK IC1 CIRCUIT
YES
−5 TO ~0 Vdc AT IC1 - 6 AS DIAL IS ROTATED FROM 2.0 TO .02
NO
CHECK IC1 CIRCUIT
4
YES
+10 TO +14.95 Vdc AT IC4-3 AS DIAL IS ROTATED FROM 2.0 TO .02
NO
CHECK IC2, Q1 & Q2 CIRCUITS
YES
−10 TO −14.95 Vdc AT IC5-3 AS DIAL IS ROTATED FROM 2.0 TO .02
NO
YES
+10 TO +14.95 Vdc AT EMITTER Q4 AS DIAL IS ROTATED FROM 2.0 TO .02
NO
CHECK IC4, Q3 & Q4 CIRCUITS
YES
−10 TO −14.95 Vdc AT EMITTER Q6 AS DIAL IS ROTATED FROM 2.0 TO .02
NO
CHECK IC5, Q5 & Q6 CIRCUITS
YES
CHECK CR6 - CR9 & CR26 INTEGRATOR CIRCUITS

*NORMAL/DOUBLE/DELAY SWITCH TO NORMAL, FREQ VERNIER TO CAL, DIAL TO 2.0, ALL OTHERS TO 12 O'CLOCK

**USE SCOPE AND HIGH IMPEDANCE PROBE FOR THIS AND SUBSEQUENT VCG MEASUREMENTS

Figure 6-3. VCG Checks, Generator Board

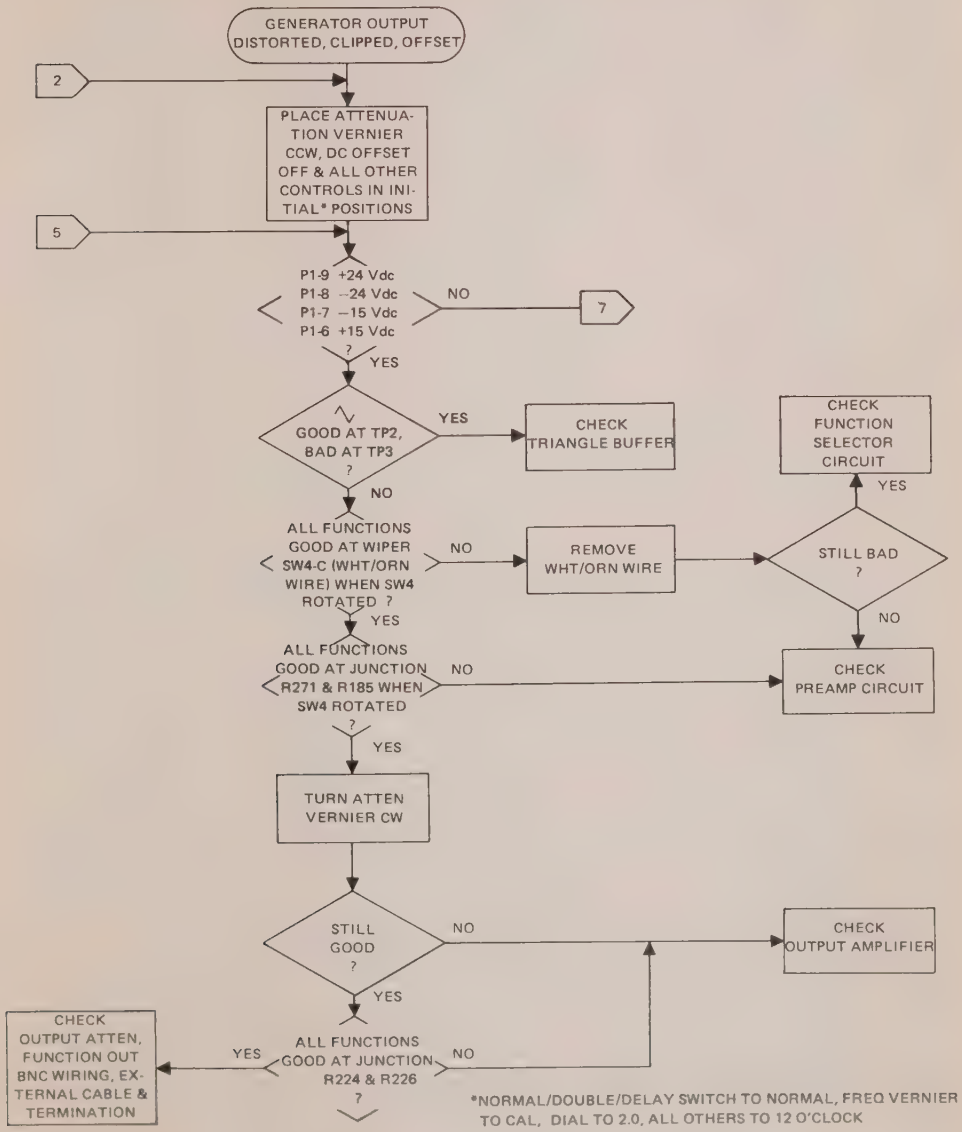
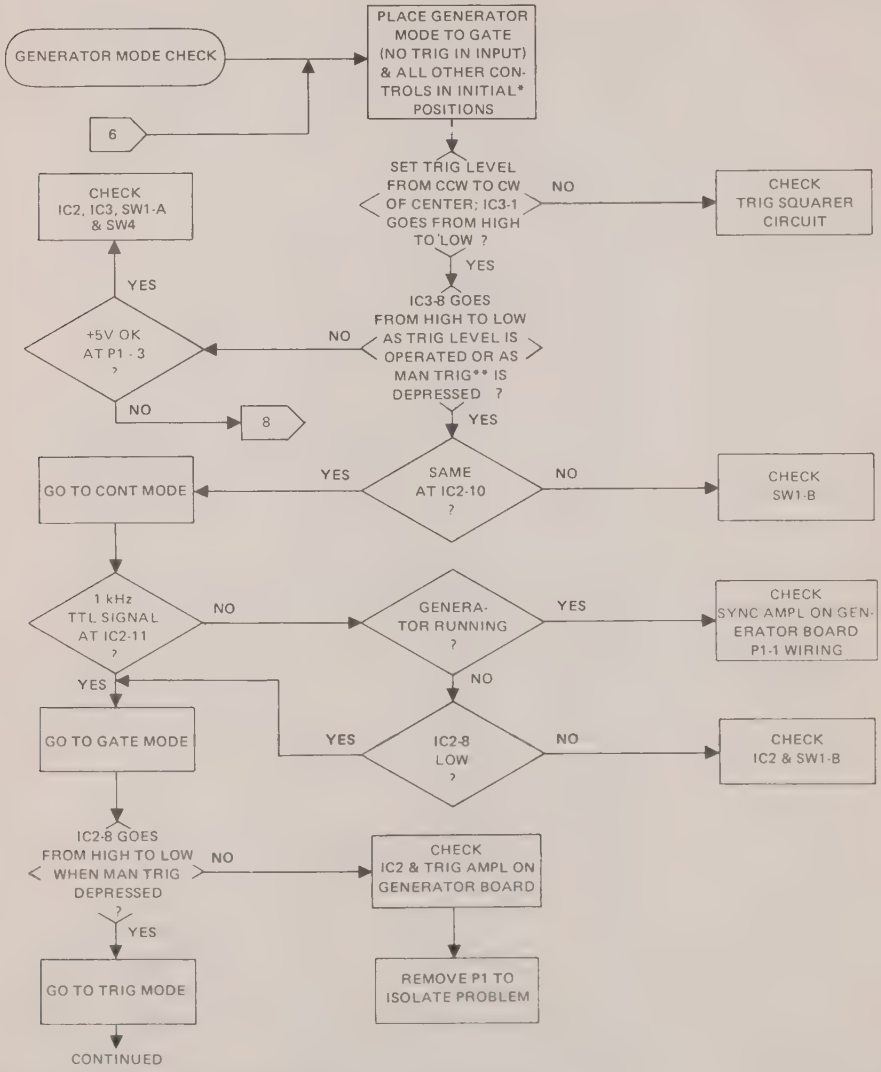


Figure 6-4. Generator Output Checks, Generator Board


GENERATOR MODE CHECK
PLACE GENERATOR MODE TO GATE (NO TRIG IN INPUT) & ALL OTHER CONTROLS IN INITIAL* POSITIONS
6
SET TRIG LEVEL FROM CCW TO CW OF CENTER; IC3-1 GOES FROM HIGH TO LOW ?
NO
CHECK TRIG SQUARER CIRCUIT
YES
CHECK IC2, IC3, SW1-A & SW4
YES
+5V OK AT P1 - 3 ?
NO
IC3-8 GOES FROM HIGH TO LOW AS TRIG LEVEL IS OPERATED OR AS MAN TRIG** IS DEPRESSED ?
NO
8
YES
GO TO CONT MODE
YES
SAME AT IC2-10 ?
NO
CHECK SW1-B
1 kHz TTL SIGNAL AT IC2-11 ?
NO
GENERATOR RUNNING ?
YES
CHECK SYNC AMPL ON GENERATOR BOARD P1-1 WIRING
YES
NO
GO TO GATE MODE
YES
IC2-8 LOW ?
NO
CHECK IC2 & SW1-B
IC2-8 GOES FROM HIGH TO LOW WHEN MAN TRIG DEPRESSED ?
NO
CHECK IC2 & TRIG AMPL ON GENERATOR BOARD
YES
GO TO TRIG MODE
REMOVE P1 TO ISOLATE PROBLEM
CONTINUED

*NORMAL/DOUBLE/DELAY SWITCH TO NORMAL, FREQ VERNIER TO CAL, DIAL TO 2.0, ALL OTHERS TO 12 O'CLOCK

**RETURN TRIG LEVEL CCW TO OPERATE MANUAL TRIGGER

Figure 6-5. Trigger and Gate Mode Checks, Trig/Pulse Board (Page 1 of 2)

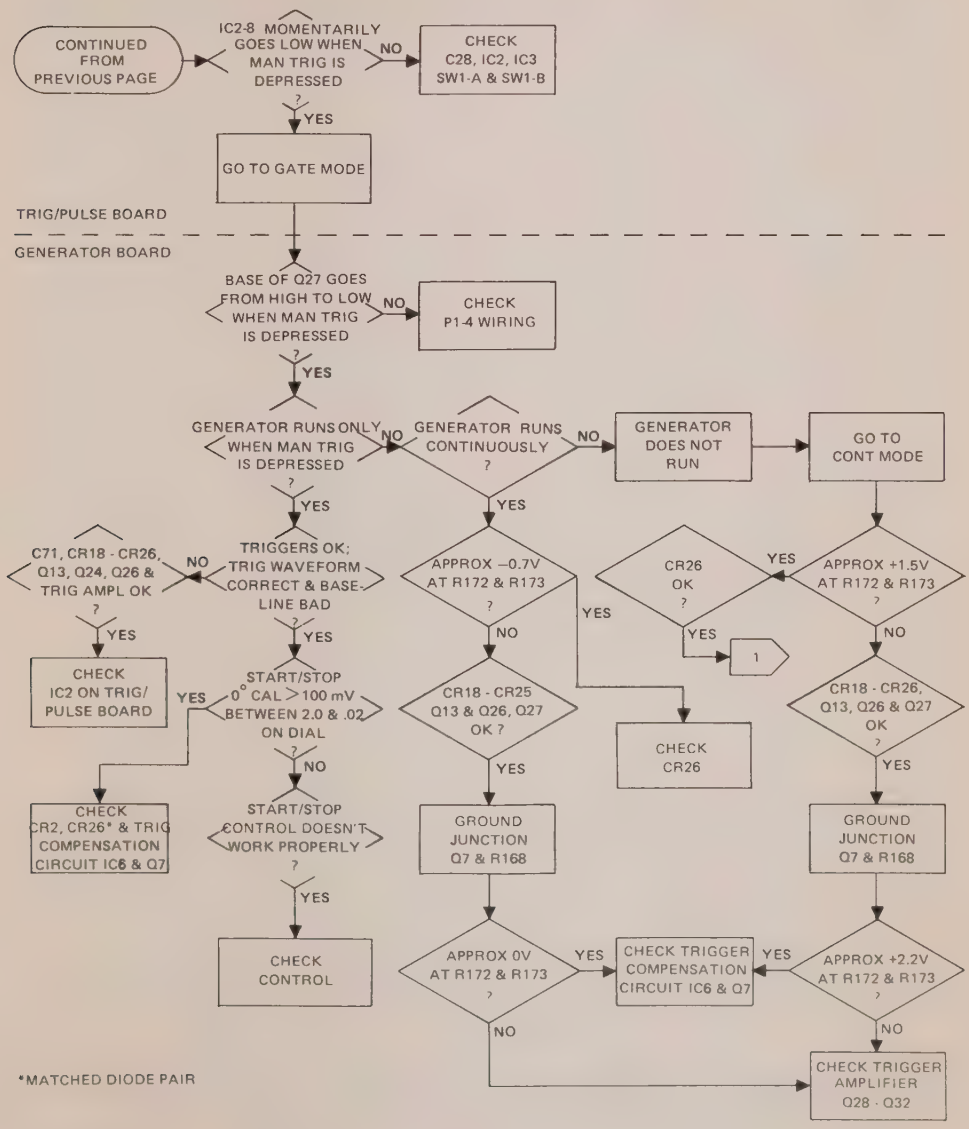


Figure 6-5. Trigger and Gate Mode Checks, Trig/Pulse Board (Page 2 of 2)

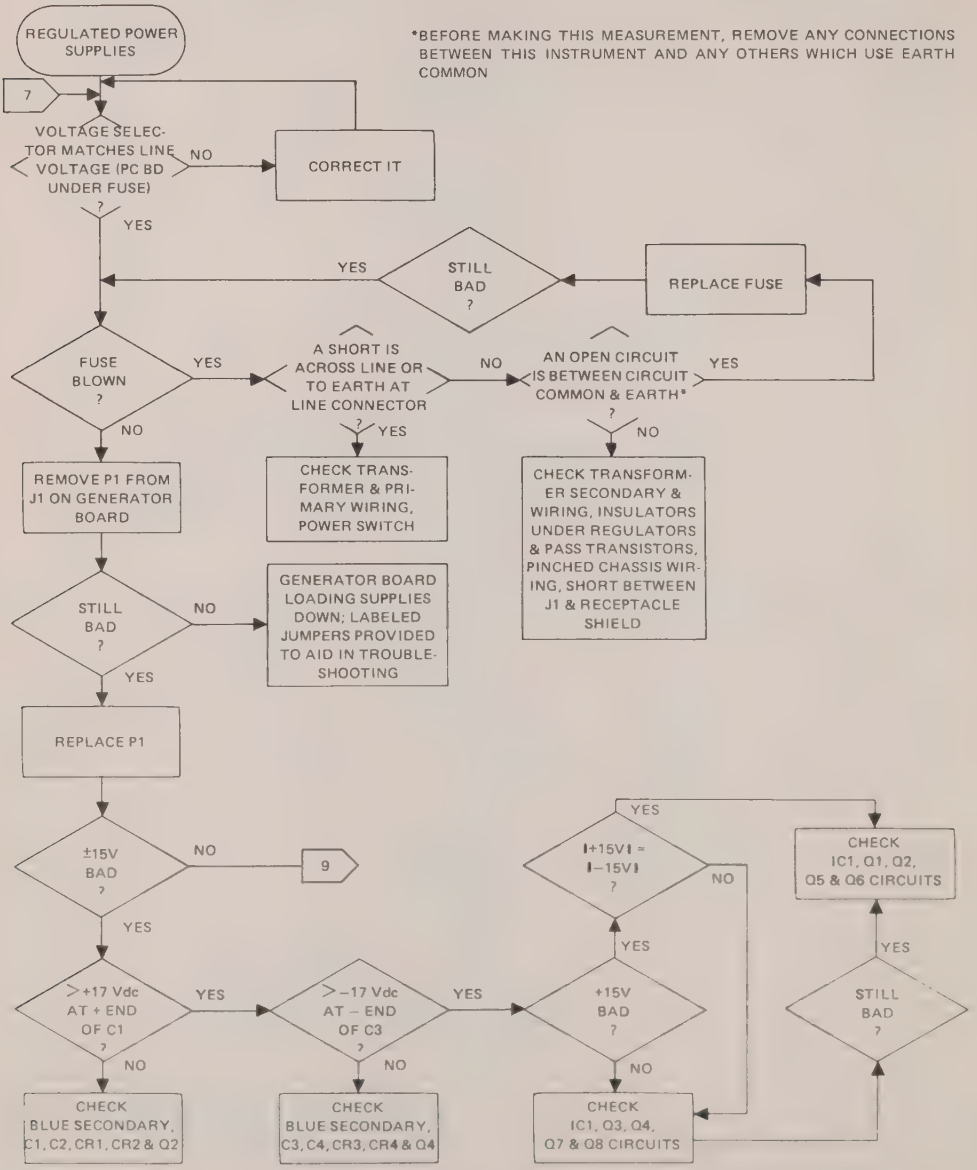

REGULATED POWER SUPPLIES
*BEFORE MAKING THIS MEASUREMENT, REMOVE ANY CONNECTIONS BETWEEN THIS INSTRUMENT AND ANY OTHERS WHICH USE EARTH COMMON
7
VOLTAGE SELECTOR MATCHES LINE VOLTAGE (PC BD UNDER FUSE) ?
NO
CORRECT IT
YES
STILL BAD ?
YES
REPLACE FUSE
FUSE BLOWN ?
YES
A SHORT IS ACROSS LINE OR TO EARTH AT LINE CONNECTOR ?
NO
AN OPEN CIRCUIT IS BETWEEN CIRCUIT COMMON & EARTH* ?
YES
NO
YES
NO
REMOVE P1 FROM J1 ON GENERATOR BOARD
CHECK TRANSFORMER & PRIMARY WIRING, POWER SWITCH
CHECK TRANSFORMER SECONDARY & WIRING, INSULATORS UNDER REGULATORS & PASS TRANSISTORS, PINCHED CHASSIS WIRING, SHORT BETWEEN J1 & RECEPTACLE SHIELD
STILL BAD ?
NO
GENERATOR BOARD LOADING SUPPLIES DOWN; LABELED JUMPERS PROVIDED TO AID IN TROUBLESHOOTING
YES
REPLACE P1
±15V BAD ?
NO
9
YES
|+15V| ≈ |−15V| ?
YES
NO
CHECK IC1, Q1, Q2, Q5 & Q6 CIRCUITS
YES
>+17 Vdc AT + END OF C1 ?
YES
>−17 Vdc AT − END OF C3 ?
YES
+15V BAD ?
YES
STILL BAD ?
NO
NO
NO
CHECK BLUE SECONDARY, C1, C2, CR1, CR2 & Q2
CHECK BLUE SECONDARY, C3, C4, CR3, CR4 & Q4
CHECK IC1, Q3, Q4, Q7 & Q8 CIRCUITS

Figure 6-6. Power Supply Checks, Trig/Pulse Board (Page 1 of 2)

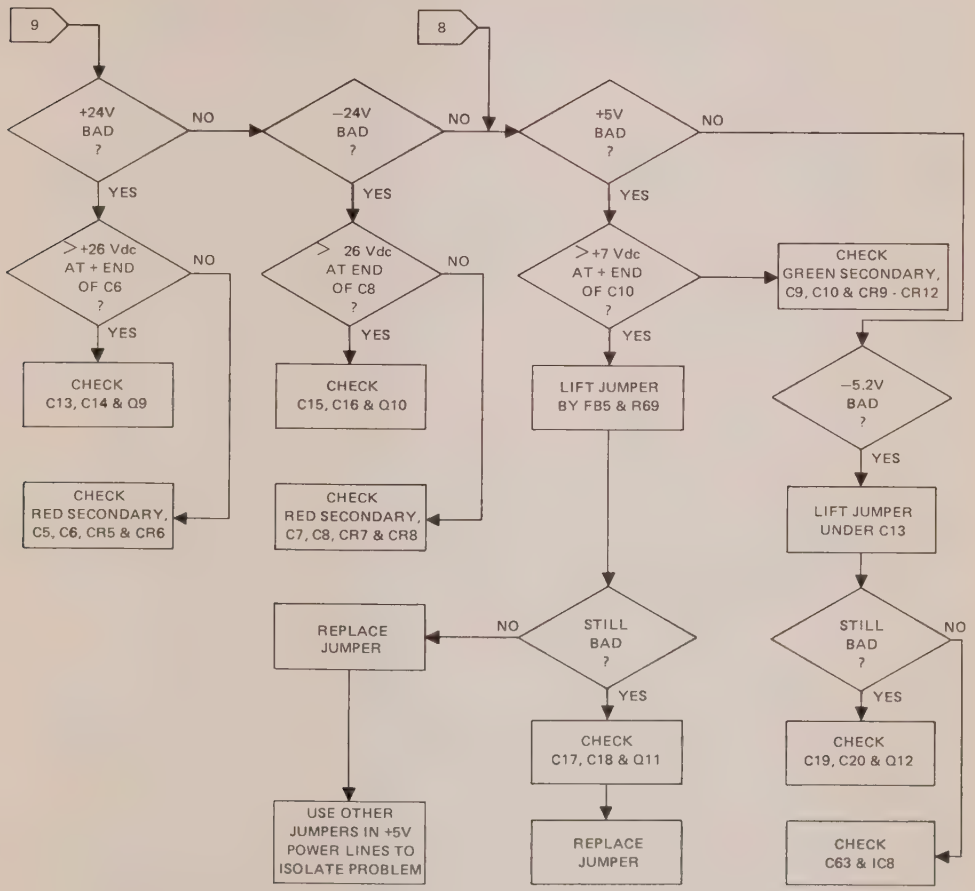


Figure 6-6. Power Supply Checks, Trig/Pulse Board (Page 2 of 2)

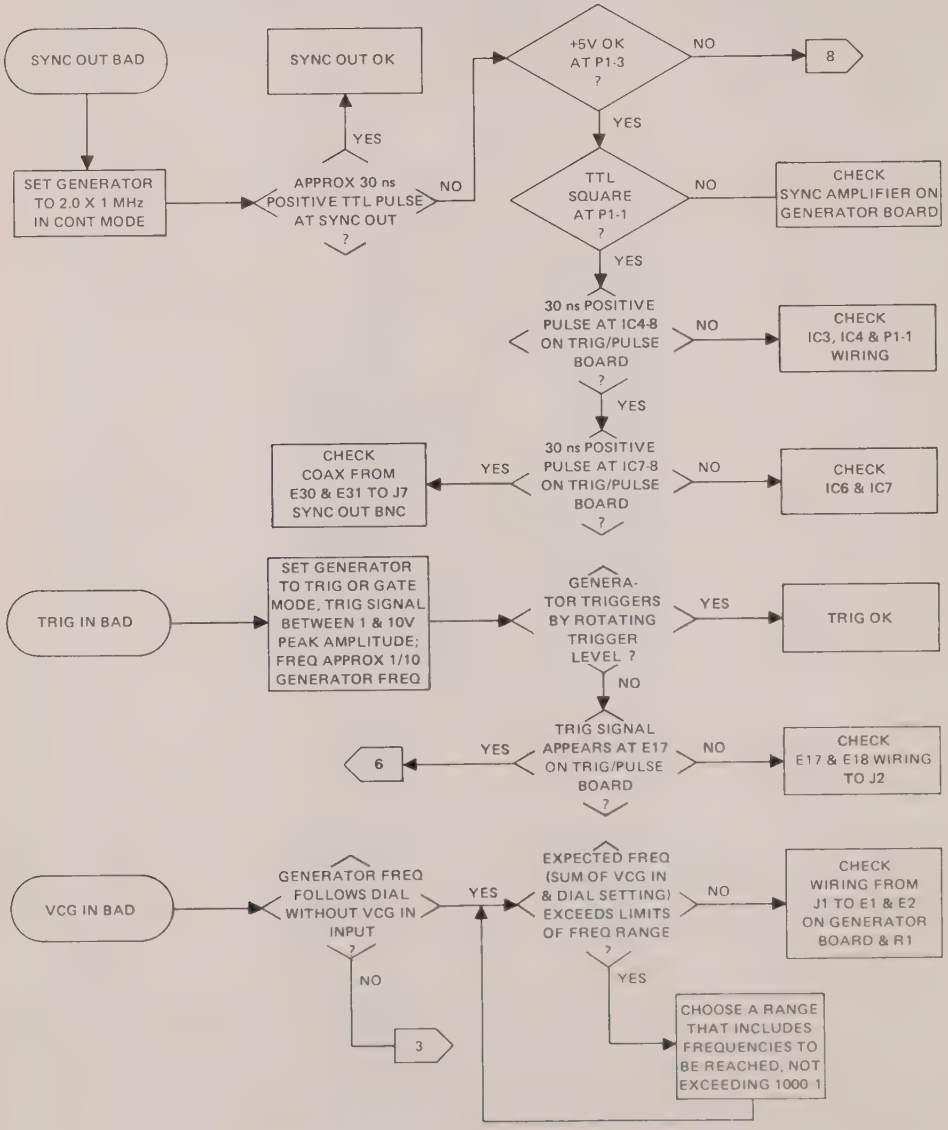

SYNC OUT BAD
SET GENERATOR TO 2.0 X 1 MHz IN CONT MODE
APPROX 30 ns POSITIVE TTL PULSE AT SYNC OUT ?
NO
YES
SYNC OUT OK
+5V OK AT P1-3 ?
NO
8
YES
TTL SQUARE AT P1-1 ?
NO
CHECK SYNC AMPLIFIER ON GENERATOR BOARD
YES
30 ns POSITIVE PULSE AT IC4-8 ON TRIG/PULSE BOARD ?
NO
CHECK IC3, IC4 & P1-1 WIRING
YES
30 ns POSITIVE PULSE AT IC7-8 ON TRIG/PULSE BOARD ?
NO
CHECK IC6 & IC7
YES
CHECK COAX FROM E30 & E31 TO J7 SYNC OUT BNC
TRIG IN BAD
SET GENERATOR TO TRIG OR GATE MODE, TRIG SIGNAL BETWEEN 1 & 10V PEAK AMPLITUDE; FREQ APPROX 1/10 GENERATOR FREQ
GENERATOR TRIGGERS BY ROTATING TRIGGER LEVEL ?
YES
TRIG OK
NO
TRIG SIGNAL APPEARS AT E17 ON TRIG/PULSE BOARD ?
NO
CHECK E17 & E18 WIRING TO J2
YES
6
VCG IN BAD
GENERATOR FREQ FOLLOWS DIAL WITHOUT VCG IN INPUT ?
YES
NO
3
EXPECTED FREQ (SUM OF VCG IN & DIAL SETTING) EXCEEDS LIMITS OF FREQ RANGE ?
NO
CHECK WIRING FROM J1 TO E1 & E2 ON GENERATOR BOARD & R1
YES
CHOOSE A RANGE THAT INCLUDES FREQUENCIES TO BE REACHED, NOT EXCEEDING 1000 1

Figure 6-7. Generator Input and Output Checks (Page 1 of 2)

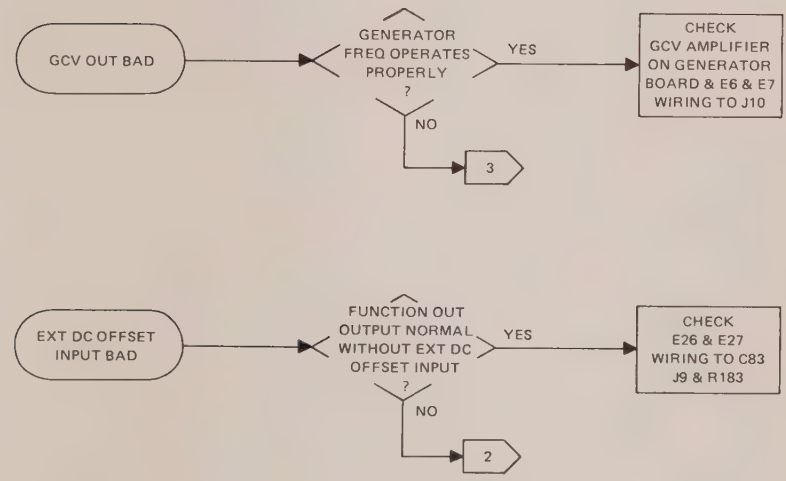

GCV OUT BAD
GENERATOR FREQ OPERATES PROPERLY ?
YES
CHECK GCV AMPLIFIER ON GENERATOR BOARD & E6 & E7 WIRING TO J10
NO
3
EXT DC OFFSET INPUT BAD
FUNCTION OUT OUTPUT NORMAL WITHOUT EXT DC OFFSET INPUT ?
YES
CHECK E26 & E27 WIRING TO C83 J9 & R183
NO
2

Figure 6-7. Generator Input and Output Checks (Page 2 of 2)

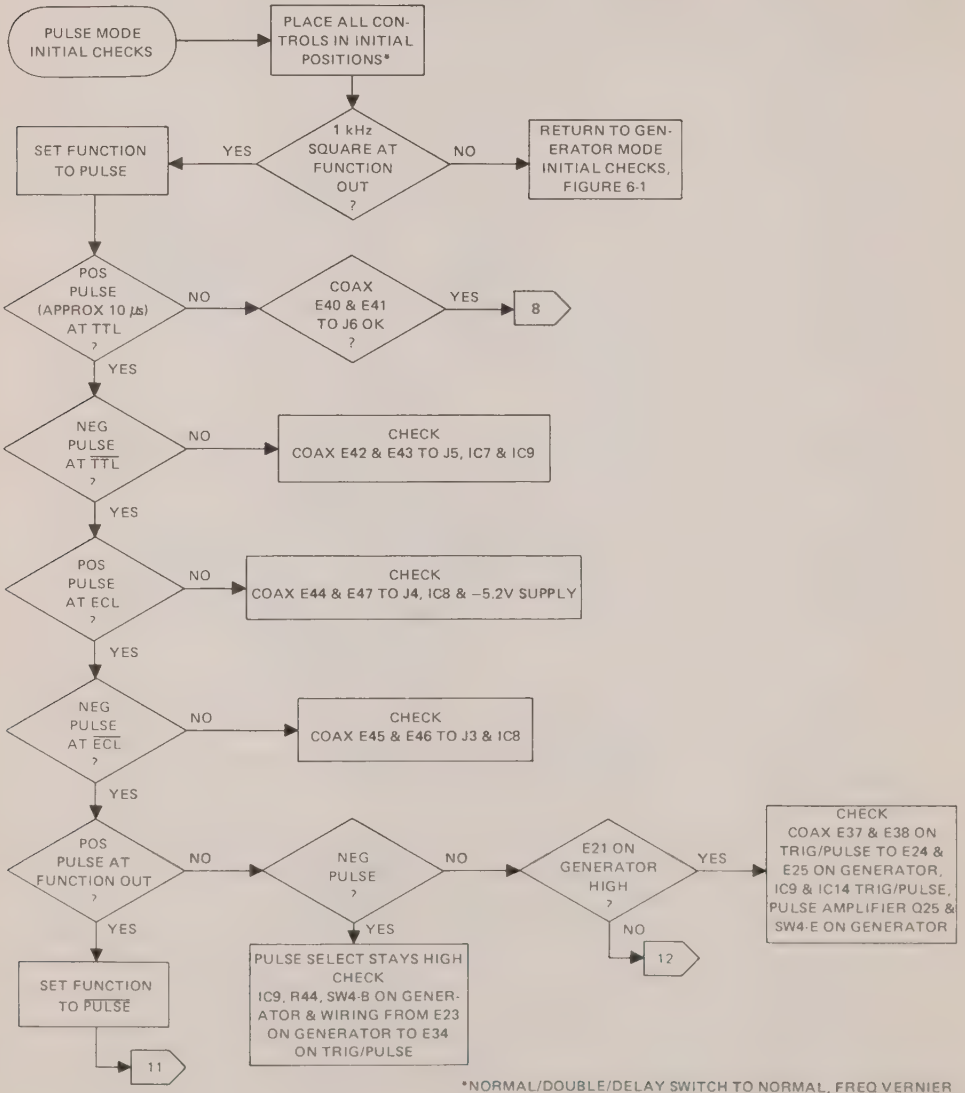

PULSE MODE INITIAL CHECKS
PLACE ALL CONTROLS IN INITIAL POSITIONS*
1 kHz SQUARE AT FUNCTION OUT ?
YES
NO
SET FUNCTION TO PULSE
RETURN TO GENERATOR MODE INITIAL CHECKS, FIGURE 6-1
POS PULSE (APPROX 10 µs) AT TTL ?
NO
COAX E40 & E41 TO J6 OK ?
YES
8
YES
NEG PULSE AT TTL ?
NO
CHECK COAX E42 & E43 TO J5, IC7 & IC9
YES
POS PULSE AT ECL ?
NO
CHECK COAX E44 & E47 TO J4, IC8 & −5.2V SUPPLY
YES
NEG PULSE AT ECL ?
NO
CHECK COAX E45 & E46 TO J3 & IC8
YES
POS PULSE AT FUNCTION OUT ?
NO
NEG PULSE ?
NO
E21 ON GENERATOR HIGH ?
YES
CHECK COAX E37 & E38 ON TRIG/PULSE TO E24 & E25 ON GENERATOR, IC9 & IC14 TRIG/PULSE, PULSE AMPLIFIER Q25 & SW4-E ON GENERATOR
YES
NO
12
YES
PULSE SELECT STAYS HIGH CHECK IC9, R44, SW4-B ON GENERATOR & WIRING FROM E23 ON GENERATOR TO E34 ON TRIG/PULSE
YES
SET FUNCTION TO PULSE
11
*NORMAL/DOUBLE/DELAY SWITCH TO NORMAL, FREQ VERNIER TO CAL, DIAL TO 2.0, ALL OTHERS TO 12 O'CLOCK

Figure 6-8. Pulse Mode Checks, Trig/Pulse Board (Page 1 of 2)

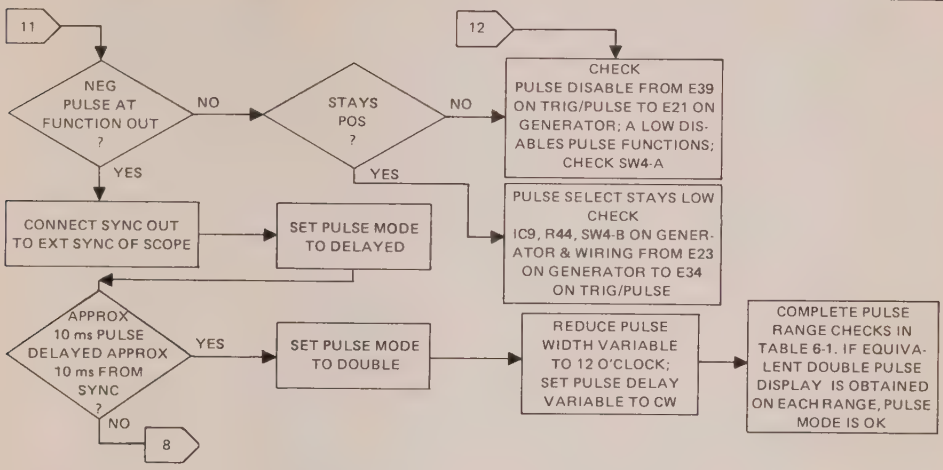

11
NEG PULSE AT FUNCTION OUT ?
NO
YES
STAYS POS ?
NO
YES
12
CHECK PULSE DISABLE FROM E39 ON TRIG/PULSE TO E21 ON GENERATOR; A LOW DISABLES PULSE FUNCTIONS; CHECK SW4-A
PULSE SELECT STAYS LOW CHECK IC9, R44, SW4-B ON GENERATOR & WIRING FROM E23 ON GENERATOR TO E34 ON TRIG/PULSE
CONNECT SYNC OUT TO EXT SYNC OF SCOPE
SET PULSE MODE TO DELAYED
APPROX 10 ms PULSE DELAYED APPROX 10 ms FROM SYNC ?
YES
NO
8
SET PULSE MODE TO DOUBLE
REDUCE PULSE WIDTH VARIABLE TO 12 O'CLOCK; SET PULSE DELAY VARIABLE TO CW
COMPLETE PULSE RANGE CHECKS IN TABLE 6-1. IF EQUIVALENT DOUBLE PULSE DISPLAY IS OBTAINED ON EACH RANGE, PULSE MODE IS OK

Figure 6-8. Pulse Mode Checks, Trig/Pulse Board (Page 2 of 2)

Table 6-1. Pulse Ranges

Pulse Width	Ranging Components	Pulse Delay	Ranging Components	Pulse Period	Scope Horizontal
OFF	IC5, SW3-A	NA	NA	NA	NA
25 ns ▮ 100 ns	C55, Q19, Q20, SW3-B	50 ns ▮ 100 ns	C40, Q16, Q17, SW2-B	> 0.5 μs	0.05 μs/div
100 ns ▮ 1 μs	C56, CR29, CR30	100 ns ▮ 1 μs	C41, CR19, CR20	> 5 μs	0.5 μs/div
1 μs ▮ 10 μs	C57, CR31, CR32	1 μs ▮ 10 μs	C42, CR21, CR22	> 50 μs	5 μs/div
10 μs ▮ 100 μs	C58, CR33, CR34	10 μs ▮ 100 μs	C43, CR23, CR24	> 0.5 ms	50 μs/div
100 μs ▮ 1 ms	C59, CR35, CR36	100 μs ▮ 1 ms	C44, CR25, CR26	> 5 ms	0.5 ms/div
100 μs ▮ 1 ms	C59, CR35, CR36	1 ms ▮ 10 ms†	C45, CR27, CR28	> 5 ms	0.5 ms/div
⎍	IC4 - IC6, SW3-A	NA	NA	0.5 ms	0.5 ms/div

†Rotate PULSE DELAY VERNIER ccw for proper display

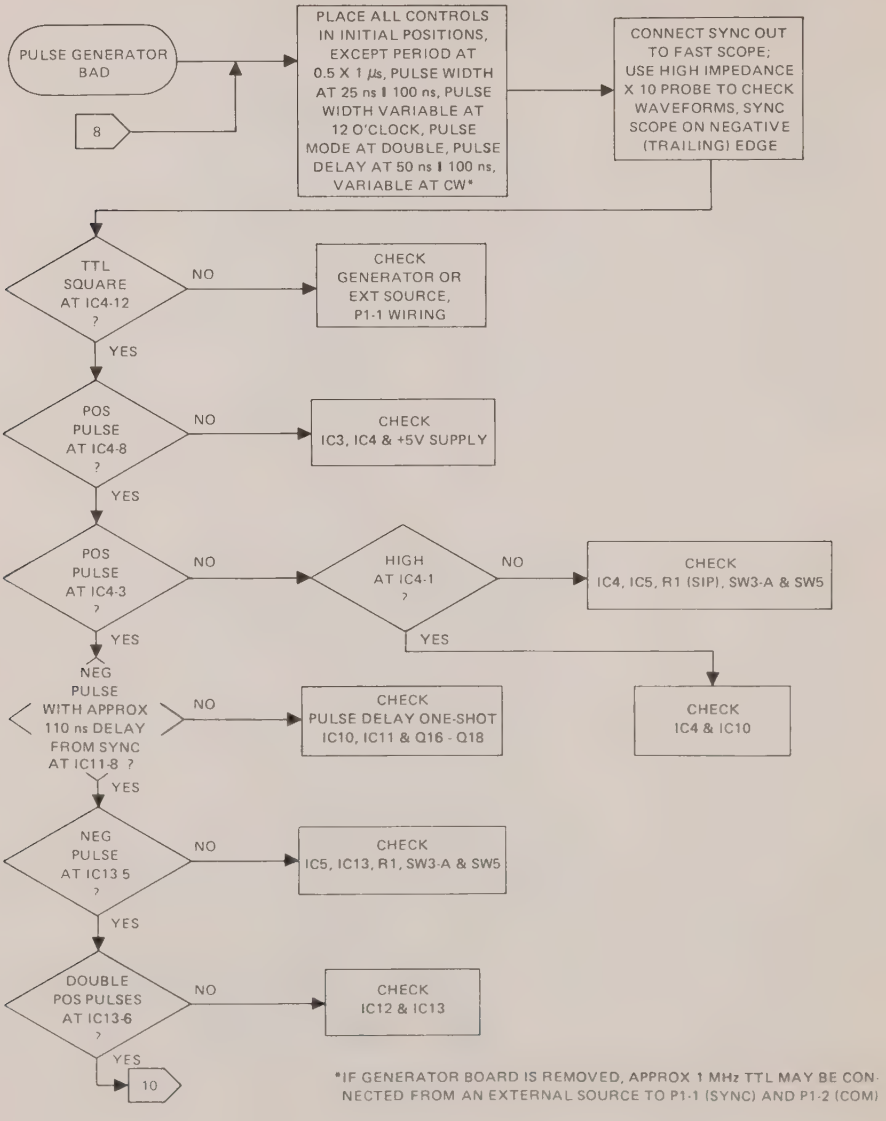

PULSE GENERATOR BAD
8
PLACE ALL CONTROLS IN INITIAL POSITIONS, EXCEPT PERIOD AT 0.5 X 1 µs, PULSE WIDTH AT 25 ns ∎ 100 ns, PULSE WIDTH VARIABLE AT 12 O'CLOCK, PULSE MODE AT DOUBLE, PULSE DELAY AT 50 ns ∎ 100 ns, VARIABLE AT CW*
CONNECT SYNC OUT TO FAST SCOPE; USE HIGH IMPEDANCE X 10 PROBE TO CHECK WAVEFORMS, SYNC SCOPE ON NEGATIVE (TRAILING) EDGE
TTL SQUARE AT IC4-12 ?
NO
CHECK GENERATOR OR EXT SOURCE, P1-1 WIRING
YES
POS PULSE AT IC4-8 ?
NO
CHECK IC3, IC4 & +5V SUPPLY
YES
POS PULSE AT IC4-3 ?
NO
HIGH AT IC4-1 ?
NO
CHECK IC4, IC5, R1 (SIP), SW3-A & SW5
YES
YES
CHECK IC4 & IC10
NEG PULSE WITH APPROX 110 ns DELAY FROM SYNC AT IC11-8 ?
NO
CHECK PULSE DELAY ONE-SHOT IC10, IC11 & Q16 - Q18
YES
NEG PULSE AT IC13 5 ?
NO
CHECK IC5, IC13, R1, SW3-A & SW5
YES
DOUBLE POS PULSES AT IC13-6 ?
NO
CHECK IC12 & IC13
YES
10
*IF GENERATOR BOARD IS REMOVED, APPROX 1 MHz TTL MAY BE CONNECTED FROM AN EXTERNAL SOURCE TO P1-1 (SYNC) AND P1-2 (COM)

Figure 6-9. Pulse Generator Checks, Trig/Pulse Board (Page 1 of 2)

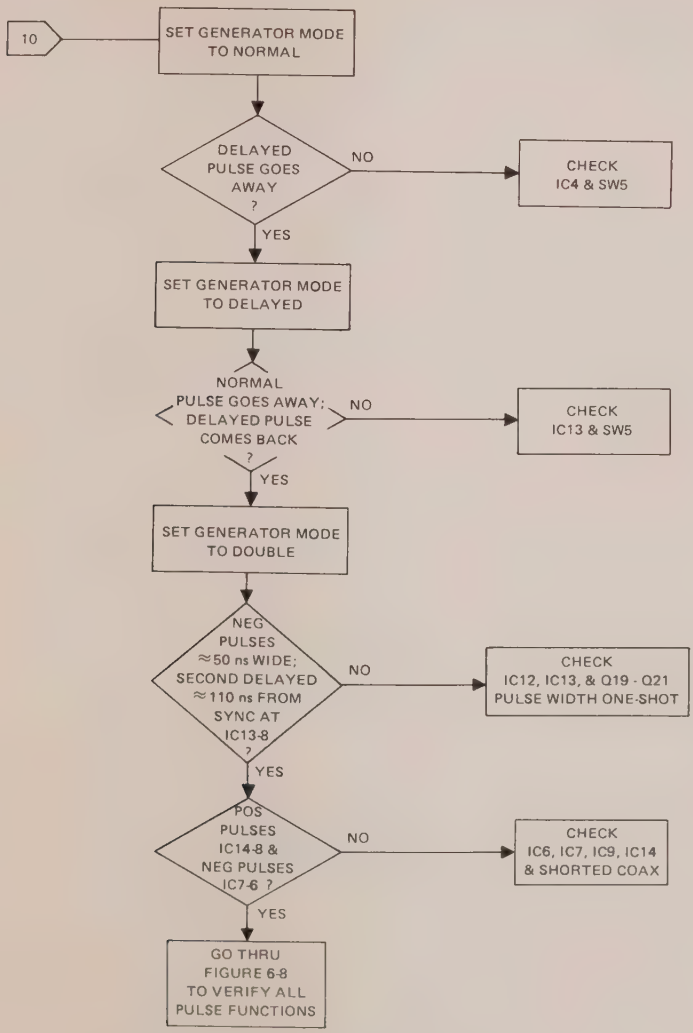

10
SET GENERATOR MODE TO NORMAL
DELAYED PULSE GOES AWAY ?
NO
CHECK IC4 & SW5
YES
SET GENERATOR MODE TO DELAYED
NORMAL PULSE GOES AWAY; DELAYED PULSE COMES BACK ?
NO
CHECK IC13 & SW5
YES
SET GENERATOR MODE TO DOUBLE
NEG PULSES ≈50 ns WIDE; SECOND DELAYED ≈110 ns FROM SYNC AT IC13-8 ?
NO
CHECK IC12, IC13, & Q19 - Q21 PULSE WIDTH ONE-SHOT
YES
POS PULSES IC14-8 & NEG PULSES IC7-6 ?
NO
CHECK IC6, IC7, IC9, IC14 & SHORTED COAX
YES
GO THRU FIGURE 6-8 TO VERIFY ALL PULSE FUNCTIONS

Figure 6-9. Pulse Generator Checks, Trig/Pulse Board (Page 2 of 2)

SECTION 7
PARTS AND SCHEMATICS

7.1 DRAWINGS

The following assembly drawings (with parts lists) and schematics are in the arrangement shown below.

7.2 ORDERING PARTS

When ordering spare parts, please specify part number, circuit reference, board, serial number of unit and, if applicable, the function performed.

7.3 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

Drawings	Drawing No.
CHASSIS	
Assembly Drawing	0102-00-0575
Schematic	0004-00-0101
Parts List	1101-00-0575
GENERATOR BOARD	
Parts Locater Drawing	0100-00-0556
Assembly Drawing (Sheet 2 of 2 only)	0101-00-0556
Schematic	0103-00-0556
Parts List	1100-00-0556
TRIG/PULSE BOARD	
Parts Locater Drawing	0100-00-0565
Assembly Drawing (Sheet 2 of 2 only)	0101-00-0565
Schematic	0103-00-0565
Parts List	1100-00-0565

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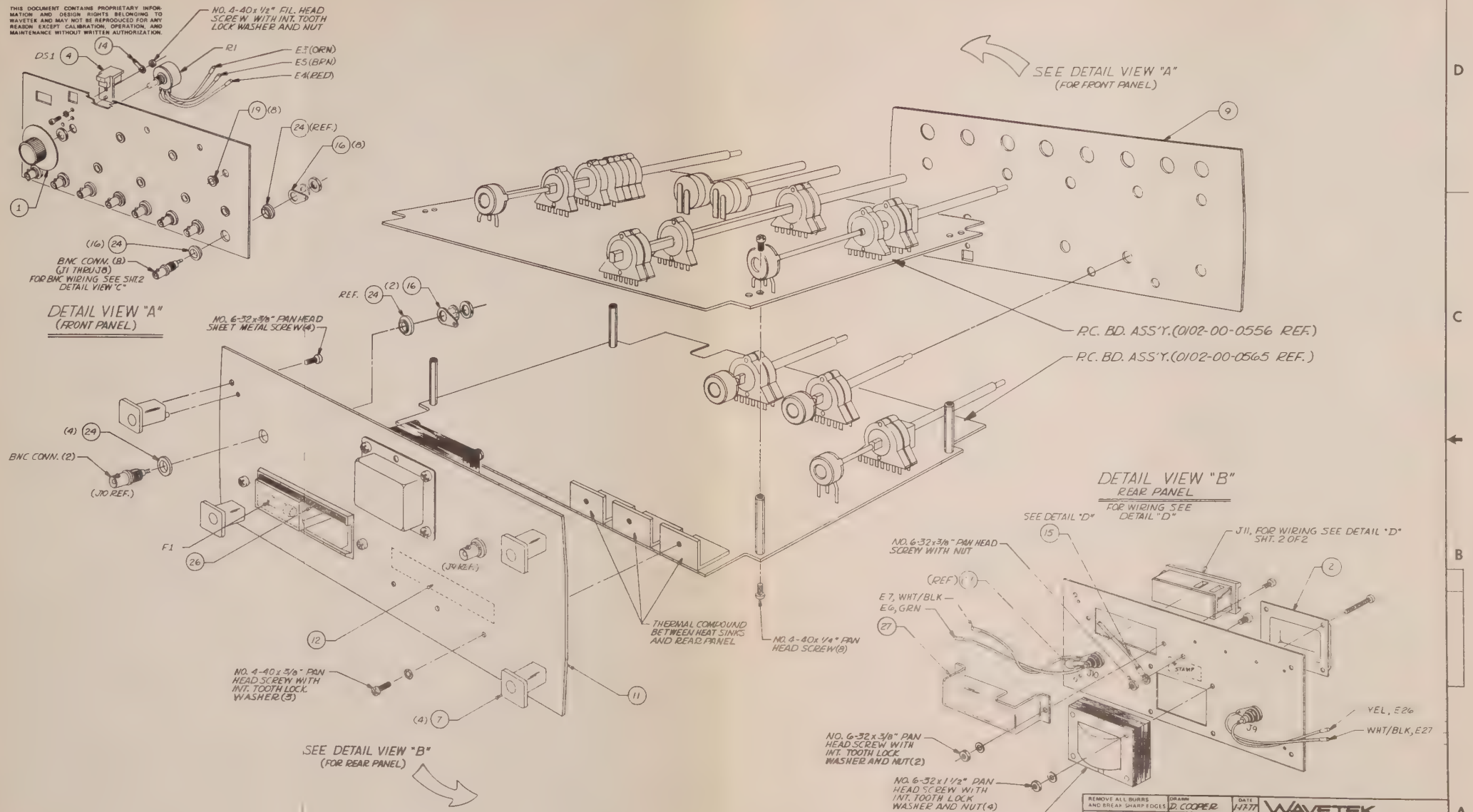
NO. 4-40 x 1/2" FIL. HEAD SCREW WITH INT. TOOTH LOCK WASHER AND NUT
DS1
R1
E3 (ORN)
E5 (BRN)
E4 (RED)
BNC CONN. (8) (J1 THRU J8) FOR BNC WIRING SEE SHT 2 DETAIL VIEW "C"
SEE DETAIL VIEW "A" (FOR FRONT PANEL)
P.C. BD. ASS'Y. (0102-00-0556 REF.)
P.C. BD. ASS'Y. (0102-00-0565 REF.)
DETAIL VIEW "A" (FRONT PANEL)
NO. 6-32 x 3/8" PAN HEAD SHEET METAL SCREW (4)
BNC CONN. (2) (J10 REF.)
F1
(J9 REF.)
THERMAL COMPOUND BETWEEN HEAT SINKS AND REAR PANEL
NO. 4-40 x 1/4" PAN HEAD SCREW (8)
NO. 4-40 x 3/8" PAN HEAD SCREW WITH INT. TOOTH LOCK WASHER (3)
SEE DETAIL VIEW "B" (FOR REAR PANEL)
DETAIL VIEW "B" REAR PANEL
FOR WIRING SEE DETAIL "D"
SEE DETAIL "D"
J11, FOR WIRING SEE DETAIL "D" SHT. 2 OF 2
NO. 6-32 x 3/8" PAN HEAD SCREW WITH NUT
E7, WHT/BLK
E6, GRN
STAMP
J10
J9
YEL, E26
WHT/BLK, E27
NO. 6-32 x 3/8" PAN HEAD SCREW WITH INT. TOOTH LOCK WASHER AND NUT (2)
NO. 6-32 x 1 1/2" PAN HEAD SCREW WITH INT. TOOTH LOCK WASHER AND NUT (4)
T1 FOR WIRING SEE DETAIL "D" SHT 2 OF 2

NOTE UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 1/27/77	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJECT NO.		TITLE ASSEMBLY STANDARD CHASSIS
FINISH WAVETEK PROCESS	RELEASE APPROV.		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		
	DO NOT SCALE DWG		
	SCALE		MODEL NO. 145 DWG NO. 0102-00-0575 REV. A
			CODE IDENT 23338 SHEET 1 OF 2

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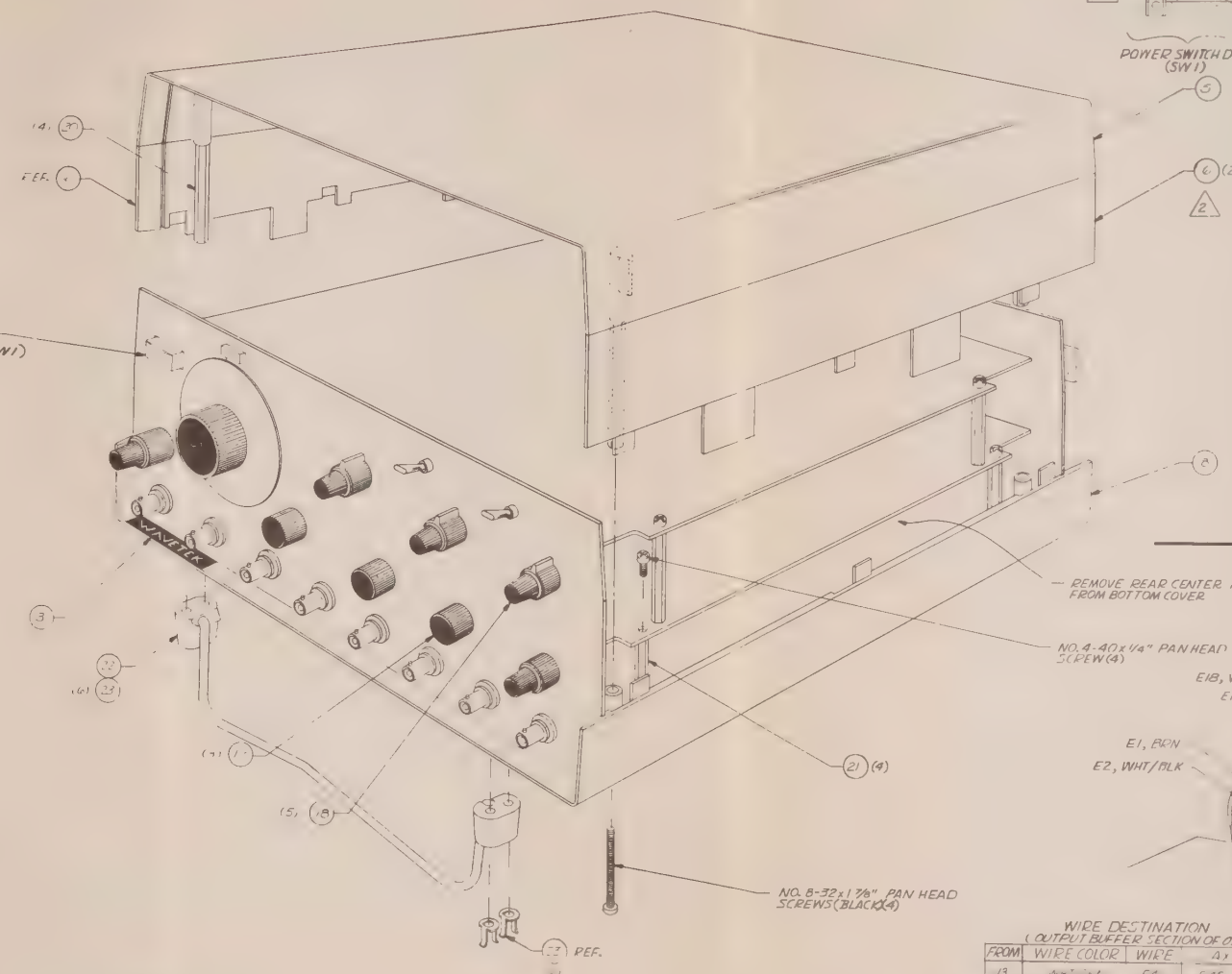
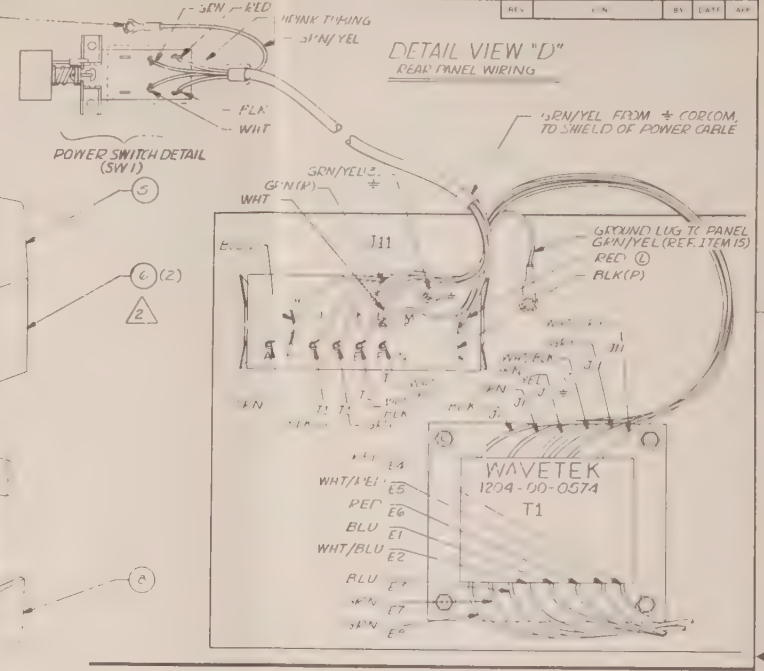
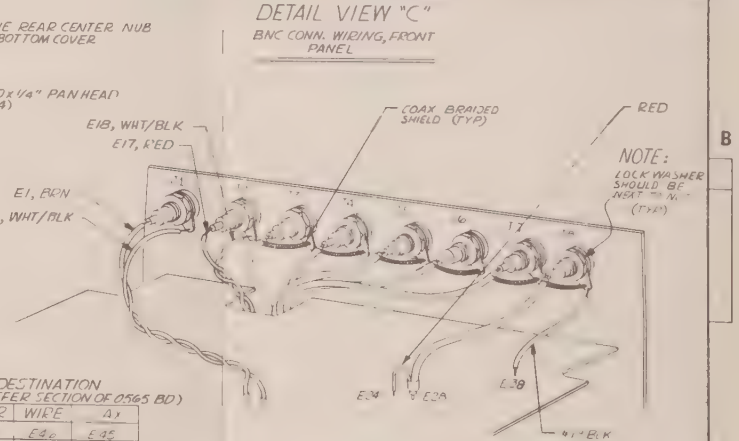

(REF. SW1)
REF.
REMOVE REAR CENTER NUB FROM BOTTOM COVER
NO. 4-40 x 1/4" PAN HEAD SCREW (4)
NO. 8-32 x 1 7/8" PAN HEAD SCREWS (BLACK) (4)
REF.
WAVETEK





WIRE DESTINATION
(OUTPUT BUFFER SECTION OF 0565 BD)

FROM	WIRE COLOR	WIRE	Δx
J3	WHT/BLK	E18	E25
J4	WHT/YEL	E47	E44
J5	WHT/GRN	E43	E42
J6	WHT/BLU	E41	E41
J7	WHT/VIO	E21	E30

(2) CEMENT ITEM 6(2) TO ITEM 5 (TYP. BOTH SIDES)

(1) MOUNT SWITCH TO P.C. BOARD PRIOR TO INSTALLING FRONT PANEL, USE NO. 2-56 x 1/4" PAN HEAD SCREW WITH NUT (2)

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN J. COOPER	DATE 4/8/77	WAVETEK SAN DIEGO, CA.
MATERIAL	PROJ. ENGR		TITLE ASSEMBLY STANDARD CHASSIS
FINISH WAVETEK PROCESS	RELEASE APPROV 3-23-77		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX .010 ANGLES 1° XX .030		MODEL NO 145
	DO NOT SCALE DWG.		DWG NO 0102-00-0575 REV A
	SCALE		NEXT ASSY 23338 SHEET 2 OF 2

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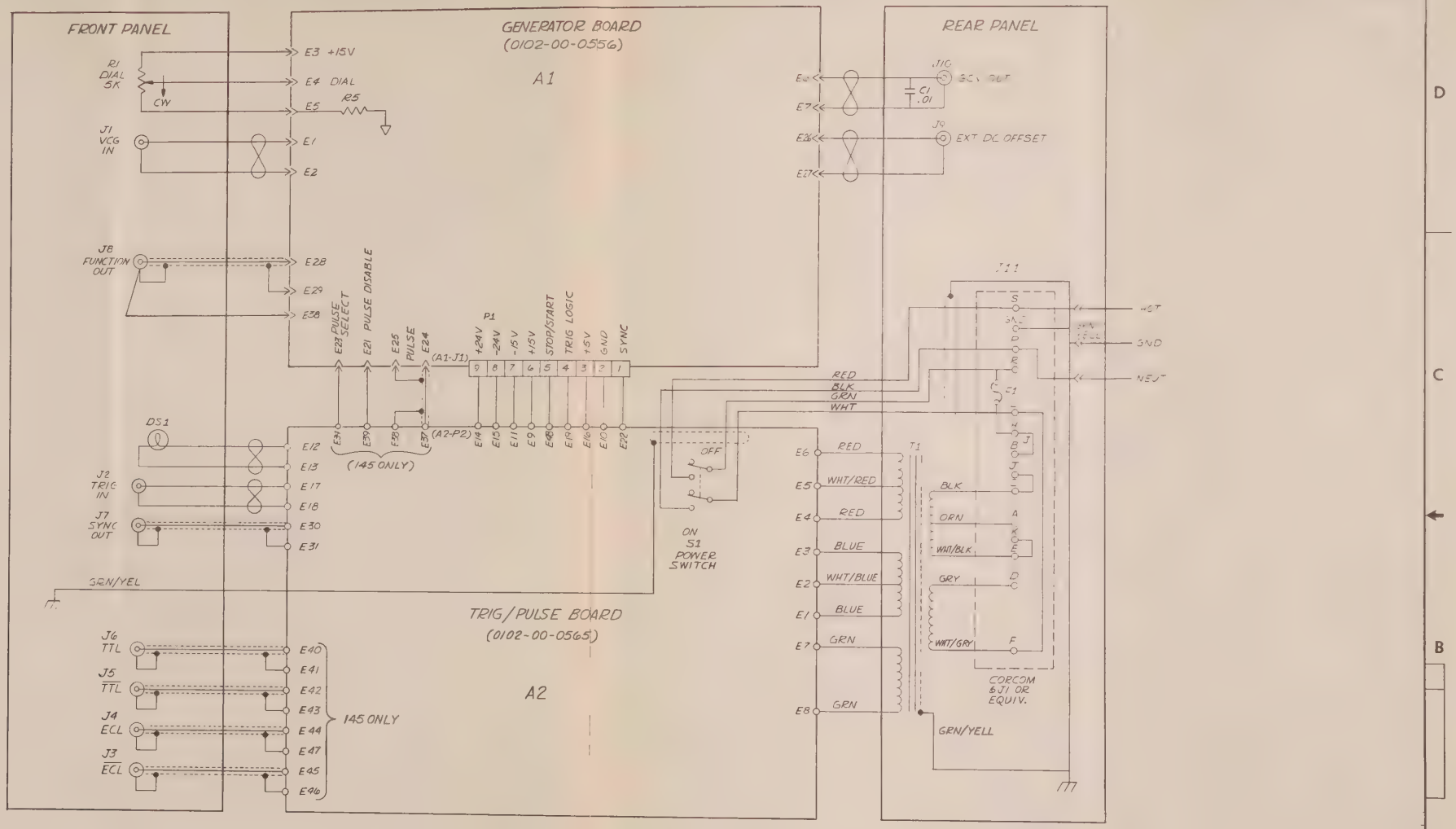

3/16A 220-240VAC
1. F1 - 3/8A 100-120 VAC

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 11-9-76	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR	3-23-77	TITLE: INSTRUMENT SCHEMATIC
FINISH WAVETEK PROCESS	RELEASE APPROV	3-23-77	
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030		MODEL NO 143/145
	DO NOT SCALE DWG		DWG NO 0004-00-0101 REV A
	SCALE		CODE IDENT 23338 SHEET 1 OF 1

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG,CHASSIS	0102-00-0575	WVTK	0102-00-0575	1
1	DIAL ASSY	1201-00-0577	WVTK	1201-00-0577	1
T1	TRANSFORMER	1204-00-0574	WVTK	1204-00-0574	1
2	END BELL	110-333	WVTK	1400-00-0174	1
3	PLATE,NAME	139-305	WVTK	1400-00-2180	1
4	INDICATOR,DIAL	180-303	WVTK	1400-00-4970	1
5	COVER,TOP	180-300-1	WVTK	1400-00-5000	1
6	EXPANDER	180-301	WVTK	1400-00-5010	2
7	POST	180-302	WVTK	1400-00-5020	4
8	COVER,BOTTOM	180-300-2	WVTK	1400-00-5030	1
27	SHIELD	1400-00-6210	WVTK	1400-00-6210	1
11	PANEL,REAR	1400-00-6760	WVTK	1400-00-6760	1
9	PANEL,FRONT	1400-00-6770	WVTK	1400-00-6770	1
12	LABEL,I.D.	1400-00-6930	WVTK	1400-00-6930	1
C1	CAP,CER,.01MF,50V	CK-103	CRL	1500-01-0310	1
J1 J10 J2 J3 J4 J5 J6 J7 J8 J9	BNC CONN	RC-/94B	KING	2100-01-0002	10
J11	RECEPTACLE	6J1	CONCM	2100-03-0026	1

WAVETEK PARTS LIST	TITLE STD CHASSIS	ASSEMBLY NO 1101-00-0575 PAGE1 1	REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
10	TERM,LUCK LUG	1414-4	SMITH	2100-04-0008	1
15	TERM,LOCK LUG	1414-6	SMITH	2100-04-0009	1
16	SOLDER LUG	1497	SMITH	2100-04-0012	10
17	STD KNOB	RS-67-1-SM-M	MOGAN	2400-01-0008	3
18	COAX KNOB SET	KM-67-1-SB+D-K-9	MOGAN	2400-01-0009	5
DS1	LAMP	CM7-7876	CMNIN	2400-02-0013	1
26	LABEL,RECEPT	85-1501	CORCM	2400-04-0002	1
F1	FUSE,125V,1/2A,SB	313.500	LITFU	2400-05-0010	1
19	BUSHING NYLINEM	4L2FF	THOMN	2800-01-0002	8
20	STANDOFF	1475-M03-F05-632	UNICP	2800-02-0010	4
21	STANDOFF	1495-M03-F05-440	UNICP	2800-02-0011	4
22	BAIL ASSY W/FT	180-508	WVTK	2800-08-0010	1
23	SPEEDNUT,SELF RETAIN	C7494-632-4	TINN	2800-09-0003	6
24	WASHER,SHOULDER	2068	SMITH	2800-27-0004	20
SW1	SWITCH ASSY PB	5102-00-0008	WVTK	5102-00-0008	1
NONE	WIRE,MU,14GA	14GA-BLACK	RMDMX	6000-31-4000	1
NONE	WIRE,MU,22GA	15U-BROWN	GAVTT	6000-32-2001	1
NONE	WIRE,MU,22GA	15U-RED	GAVTT	6000-32-2002	1

WAVETEK PARTS LIST	TITLE STD CHASSIS	ASSEMBLY NO 1101-00-0575 PAGE1 2	REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	WIRE,MU,22GA	15U-ORANGE	GAVTT	6000-32-2003	1
NONE	WIRE,MU,22GA	15U-YELLOW	GAVTT	6000-32-2004	1
NONE	WIRE,MU,22GA	15U-GREEN	GAVTT	6000-32-2005	1
NONE	WIRE,MU 22GA	15U-GRAY/YELLOW	GAVTT	6000-32-2085	1
NONE	WIRE,MU,22GA	15U-WHITE/BLACK	GAVTT	6000-32-2090	2
NONE	CABLE,COAX,26AWG	RG 174/U	TT	6001-00-0001	1
NONE	PWR CORD	0-7788-008-GY	KING	6001-80-0005	1

WAVETEK PARTS LIST	TITLE STD CHASSIS	ASSEMBLY NO 1101-00-0575 PAGE1 3	REV A

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE STD CHASSIS
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		
	DO NOT SCALE DWG		MODEL NO 145 / DWG NO 1101-00-0575 / REV A
	SCALE		CODE IDENT 23338 / SHEET OF

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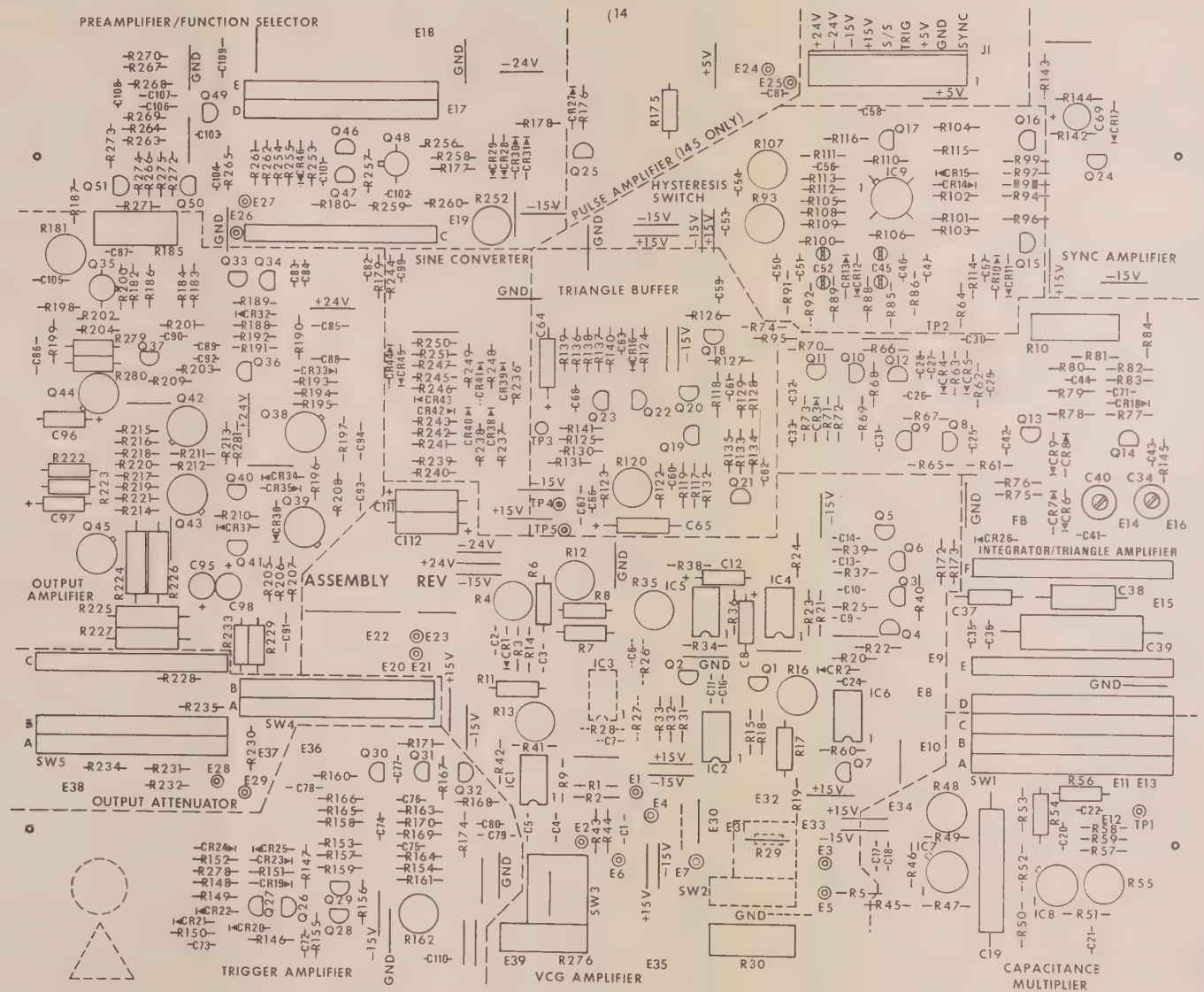

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: GENERATOR BOARD PARTS LOCATER
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		
	DO NOT SCALE DWG		MODEL NO 143/145 · DWG NO 0100-00-0556 · REV C
	SCALE		CODE IDENT 23338 · SHEET OF

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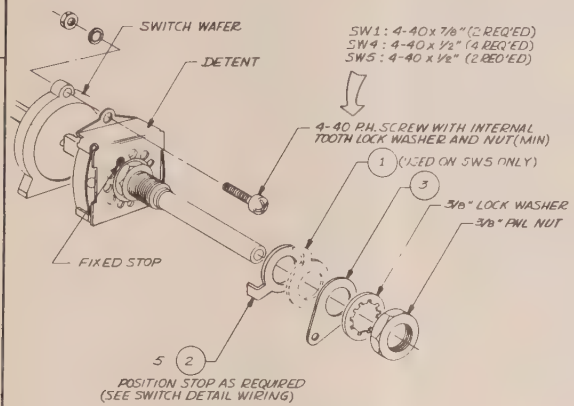
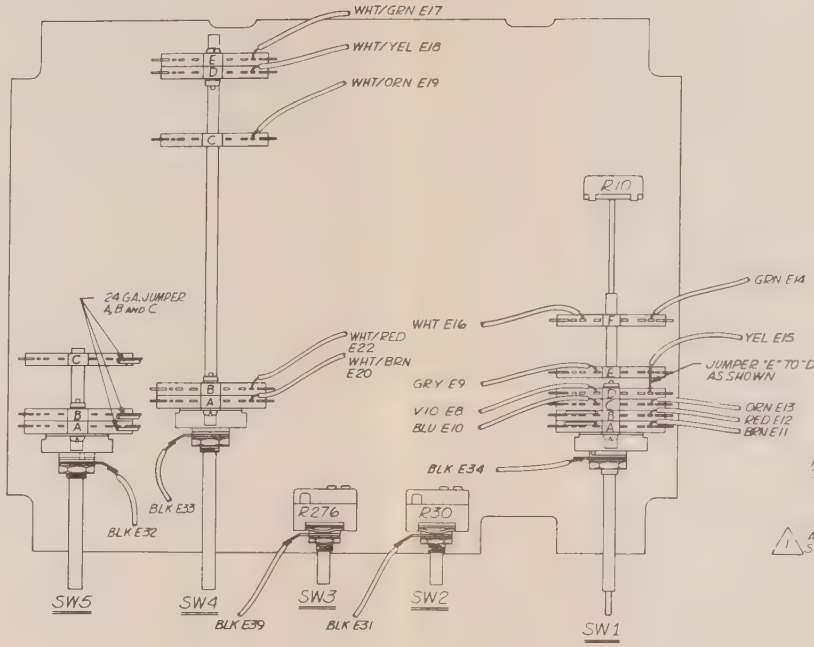
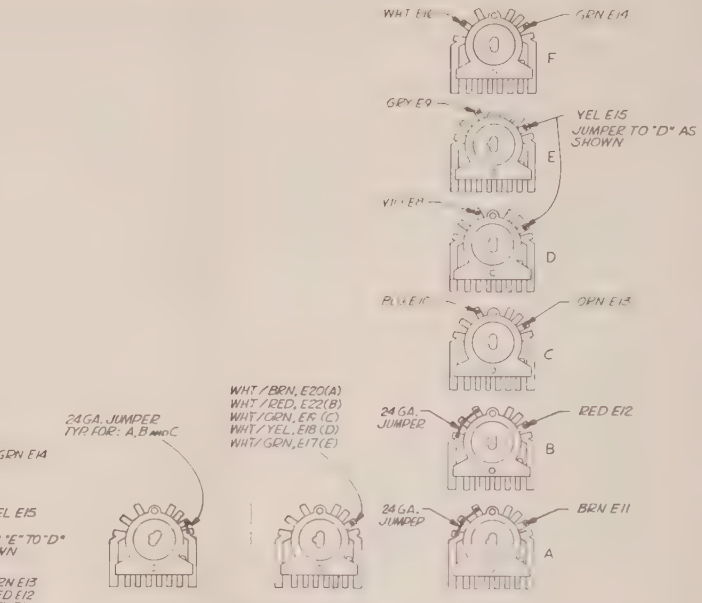
REV	ECN	BY	DATE	APP


SWITCH WAFER
DETENT
SW1 : 4-40 x 7/8" (2 REQ'ED)
SW4 : 4-40 x 1/2" (4 REQ'ED)
SW5 : 4-40 x 1/2" (2 REQ'ED)
4-40 P.H. SCREW WITH INTERNAL TOOTH LOCK WASHER AND NUT (MIN)
1 (USED ON SW5 ONLY)
3
3/8" LOCK WASHER
3/8" PNL NUT
FIXED STOP
5
2
POSITION STOP AS REQUIRED (SEE SWITCH DETAIL WIRING)

TYPICAL HARDWARE STACK-UP





DETENT SHOWN FROM FRONT VIEW IN FULL COUNTER CLOCKWISE POSSITION

1 TURN TO FULL COUNTER CLOCKWISE POSITION THEN TURN BACK CLOCKWISE ONE POSITION TO INSTALL BOTH STOPS

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN J.D. COOPER	DATE 12-6-77	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE ASSEMBLY GENERATOR BOARD
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		
	DO NOT SCALE DWG		MODEL NO 145
	SCALE		DWG NO 0101-00-0556 REV A
			CODE IDENT 23338 SHEET 2 OF 2

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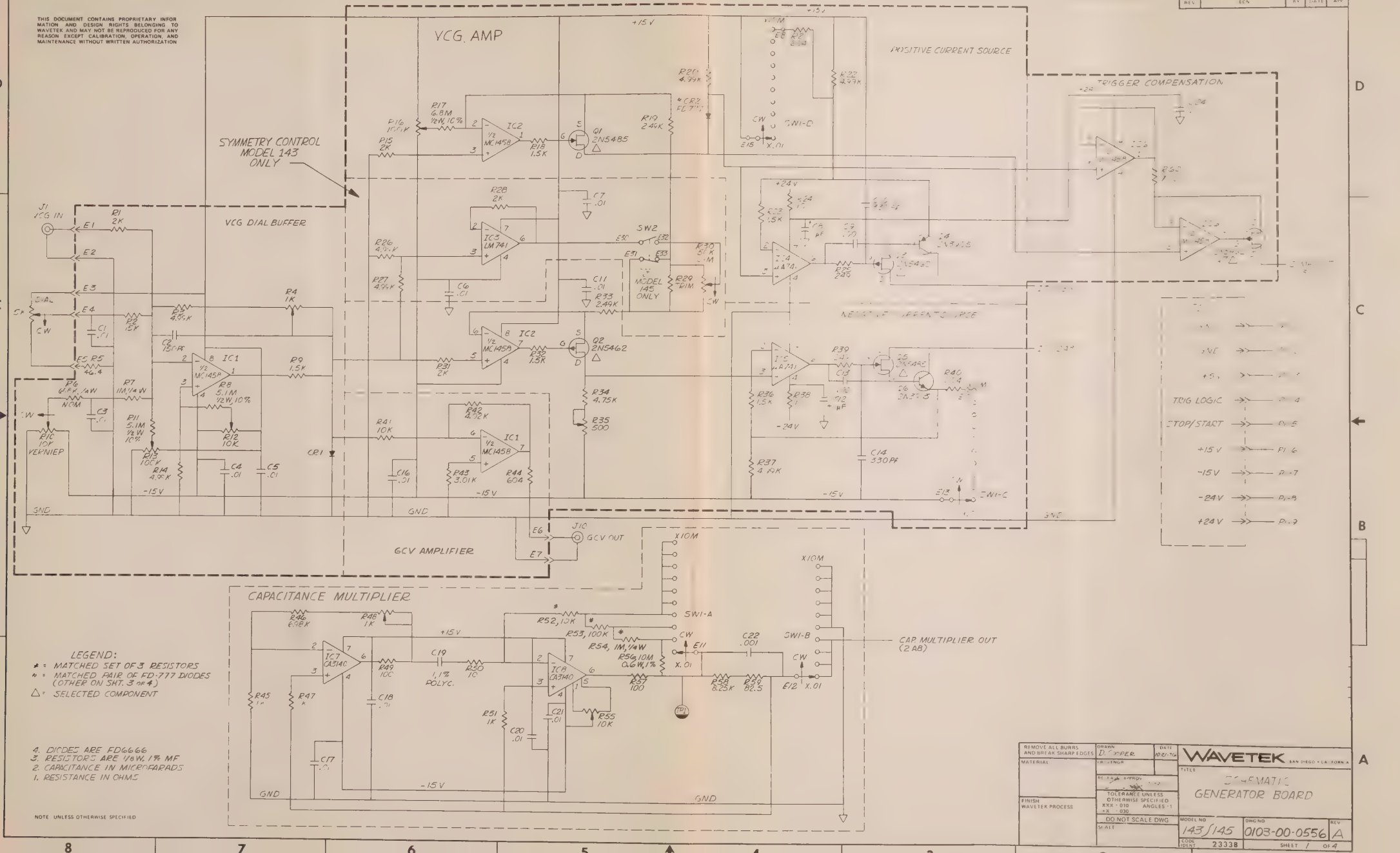

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 10-21-74	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	ENGR		TITLE SCHEMATIC GENERATOR BOARD
FINISH WAVETEK PROCESS	APPROV	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 XX ±.030 ANGLES ±1°	
	DO NOT SCALE DWG	SCALE	MODEL NO 143/145
			DWG NO 0103-00-0556 REV A
			CODE IDENT 23338 SHEET 1 OF 4

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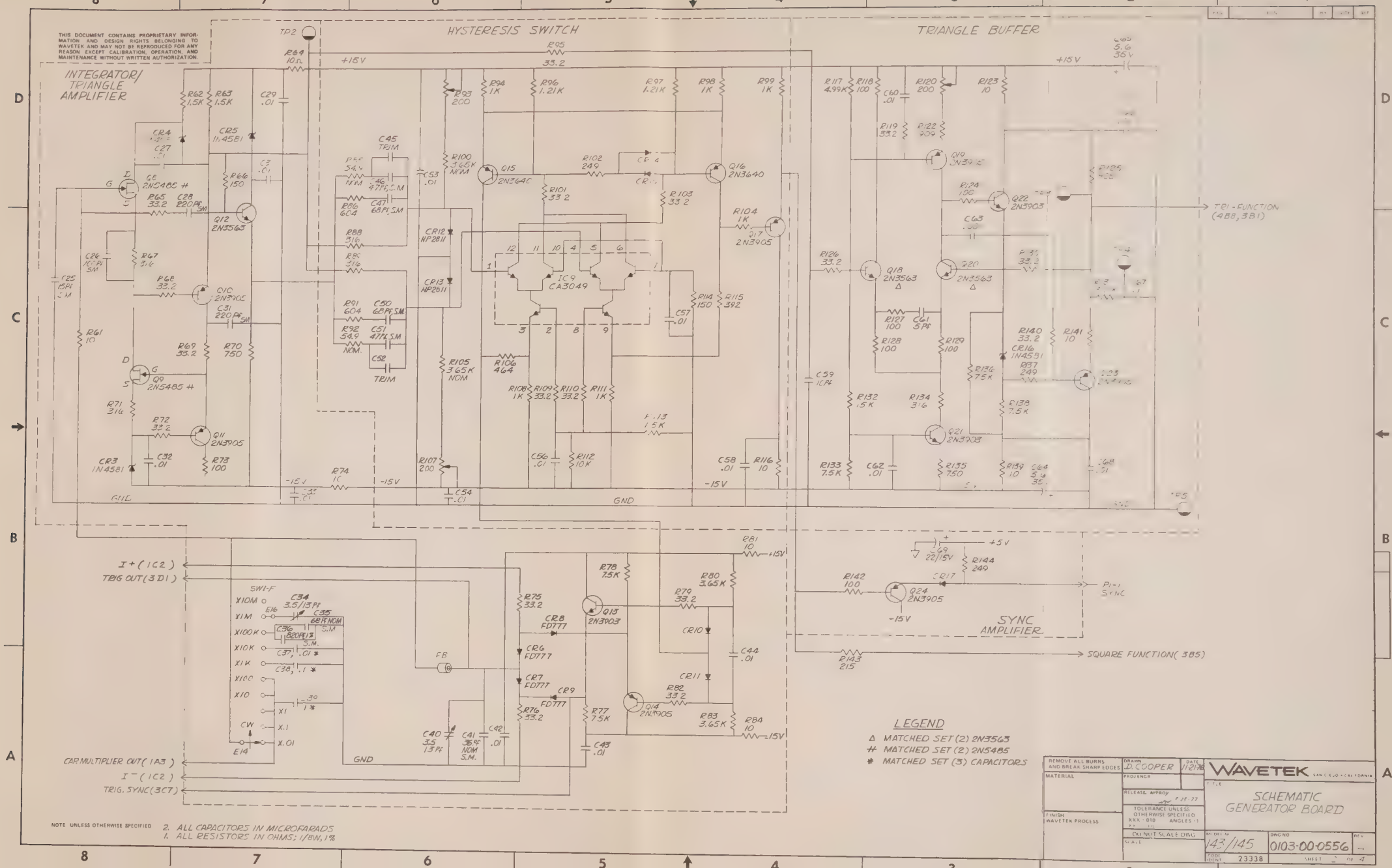

LEGEND

- Δ MATCHED SET (2) 2N3563
- # MATCHED SET (2) 2N5485
- * MATCHED SET (3) CAPACITORS

NOTE UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS IN MICROFARADS
1. ALL RESISTORS IN OHMS; 1/8W, 1%

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN J. COOPER	DATE 1/27/78	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: SCHEMATIC GENERATOR BOARD
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1°		
	DO NOT SCALE DWG		M. DEPT NO 143/145
	SCALE		DWG NO 0103-00-0556 REV —
			TOOL NO 23338 SHEET 2 OF 4

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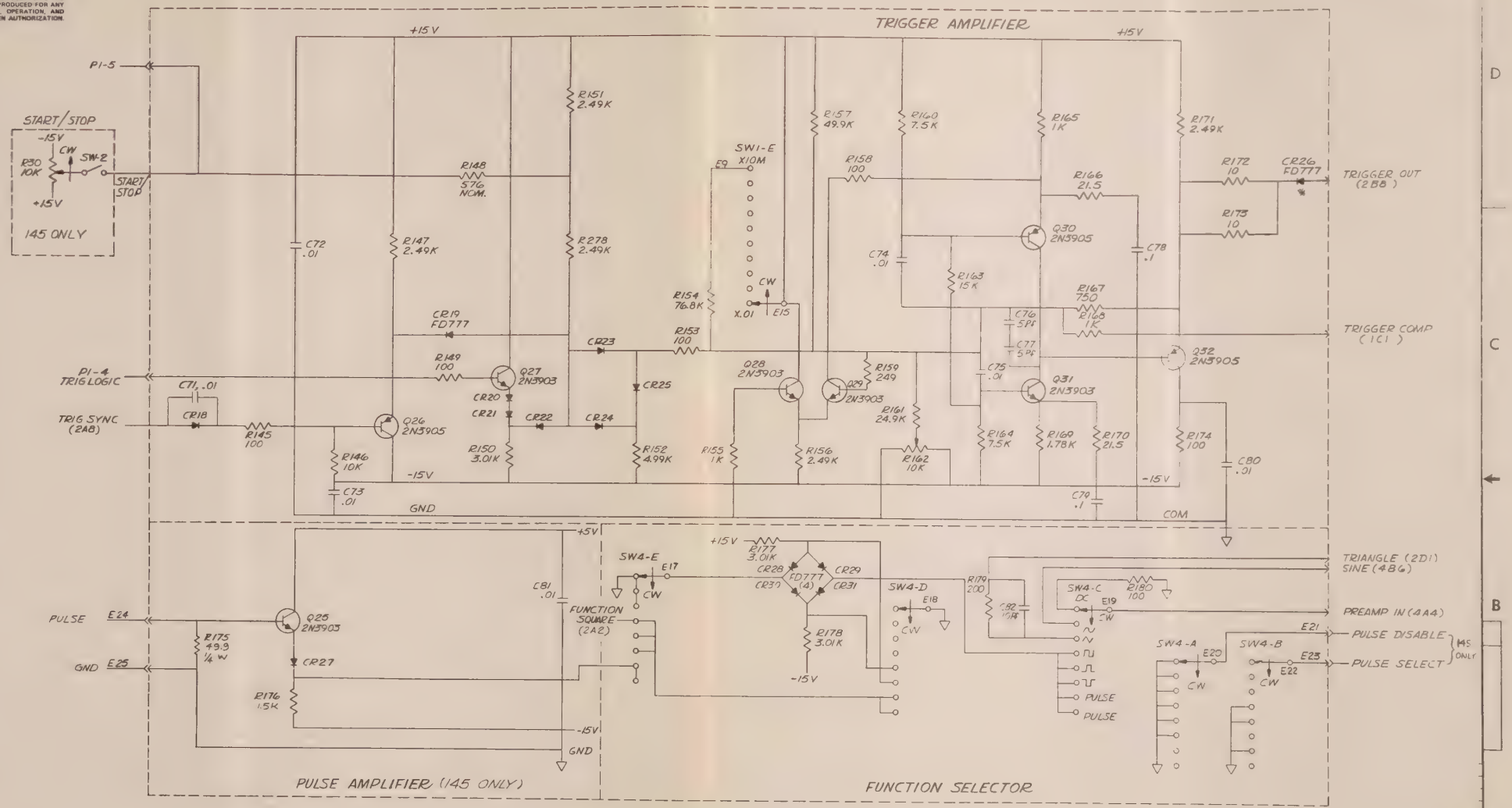

5. DIODES ARE FD6666
4. RESISTORS ARE 1/8W, 1%, MF.
3. CAPACITANCE IN MICROFARADS
2. RESISTANCE IN OHMS
1. * MATCHED PAIR OF FD777 (OTHER ON SHT. 1)

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D COOPER	DATE 11-8-76
MATERIAL	PROJENGR	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± 010 ANGLES ± 1 XX ± 030	DO NOT SCALE DWG

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: SCHEMATIC GENERATOR BOARD

MODEL NO: 143/145

DWG NO: 0103-00-055 E

SIZE: D

CODE IDENT: 23338

SHEET

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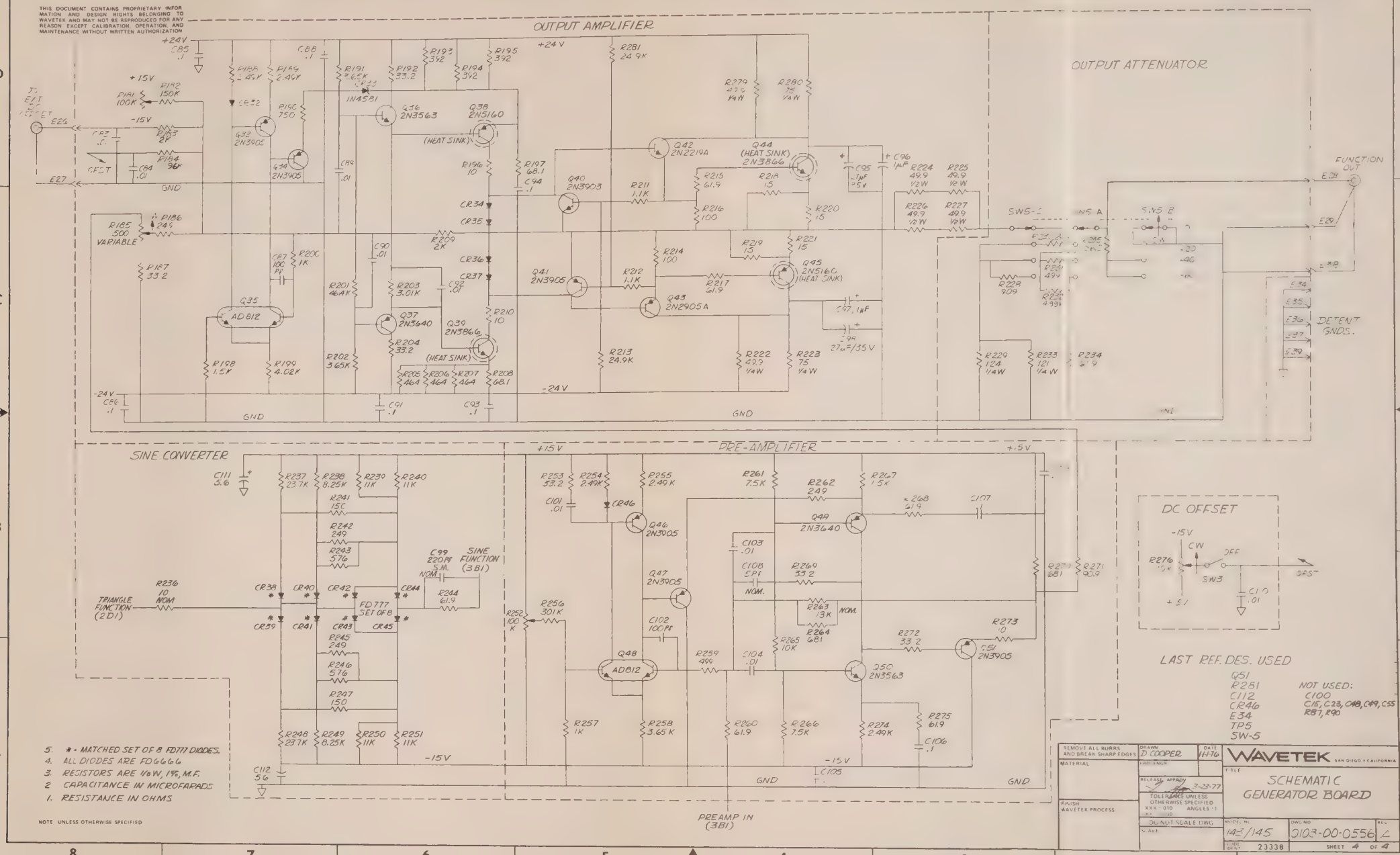

LAST REF. DES. USED

Q51
R281
C112
CR46
E34
TP5
SW-5

NOT USED:
C100
C15, C23, C48, C49, C55
R87, R90

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 11-76	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL			TITLE: SCHEMATIC GENERATOR BOARD
FINISH WAVETEK PROCESS	RELEASE APPROV	3-23-77	
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1		
	DO NOT SCALE DWG		MODEL NO. 143/145 DWG NO. 0103-00-0556 REV. L
	SCALE		CAGE CODE 23338 SHEET 4 OF 4

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	OWIG-MFGN-PART-NO	MFGN	WAVETEK NO.	QTY/PT
R96 R97	RES,MF,1/8W,1%,1.21K	RN55D-1211F	TRW	4701-03-1211	2
R263T	RES,MF,1/8W,1%,13K	RN55D-1302F	TRW	4701-03-1302	1
R114 R241 R247 R66	RES,MF,1/8W,1%,150	RN55D-1500F	TRW	4701-03-1500	4
R113 R176 R18 R198 R23 R267 R32 R36 R62 R63 R9	RES,MF,1/8W,1%,1.5K	RN55D-1501F	TRW	4701-03-1501	11
R132 R163 R2	RES,MF,1/8W,1%,15K	RN55D-1502F	TRW	4701-03-1502	3
R162	RES,MF,1/8W,1%,150K	RN55D-1503F	TRW	4701-03-1503	1
R218 R219 R220 R221	RES,MF,1/8W,1%,15	RN55D-15R0F	TRW	4701-03-1509	4
R169	RES,MF,1/8W,1%,1.78K	RN55D-1781F	TRW	4701-03-1781	1
R184	RES,MF,1/8W,1%,1.96K	RN55D-1961F	TRW	4701-03-1961	1
R179	RES,MF,1/8W,1%,200	RN55D-2000F	TRW	4701-03-2000	1
R1 R15 R183 R209 R31	RES,MF,1/8W,1%,2K	RN55D-2001F	TRW	4701-03-2001	5
R143	RES,MF,1/8W,1%,215	RN55D-2150F	TRW	4701-03-2150	1
R166 R170	RES,MF,1/8W,1%,21.5	RN55D-21R5F	TRW	4701-03-2159	2
R237 R248	RES,MF,1/8W,1%,23.7K	RN55D-2372F	TRW	4701-03-2372	2
R102 R137 R168 R159 R186 R230 R242 R245 R25 R262 R39	RES,MF,1/8W,1%,249	RN55D-2490F	TRW	4701-03-2490	11
R147 R151 R156 R171 R180 R199 R19 R258 R278 R33	RES,MF,1/8W,1%,2.49K	RN55D-2491F	TRW	4701-03-2491	12

WAVETEK PARTS LIST	TITLE PCA,GENERATOR	ASSEMBLY NO 1100-00-0556 PAGE: 5	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	OWIG-MFGN-PART-NO	MFGN	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG GENERATOR	0101-00-0556	WVTK	0101-00-0556	1
NONE	SCHEMATIC GENERATOR	0103-00-0556	WVTK	0103-00-0556	1
C100T C61 C76 C77	CAP,CER,5PF,1KV	DD-050	CML	1500-00-5011	4
C59 C82	CAP,CER,10PF,1KV	DD-100	CML	1500-01-0011	2
C102 C87	CAP,CER,100PF,1KV	DD-101	CML	1500-01-0111	2
C13 C22 C63 C9	CAP,CER,.001MF,1KV	DD-102	CML	1500-01-0211	4
C1 C101 C103 C104 C11 C110 C16 C17 C18 C20 C21 C24 C27 C29 C3 C30 C32 C33 C4 C42 C43 C48 C5 C53 C54 C56 C57 C58 C60 C62 C66 C68 C71 C72 C73 C74 C75 C80 C81 C83 C84 C89 C90 C92	CAP,CER,.01MF,50V	CK-103	CML	1500-01-0310	44
C105 C106 C107 C109 C67 C78 C79 C85 C86 C88 C91 C93 C94	CAP,CER,.1MF,50V	CK-104	CML	1500-01-0410	13
C2	CAP,CER,150PF,1KV	DD-151	CML	1500-01-5111	1
C10 C14	CAP,CER,330PF,1KV	DD-331	CML	1500-03-3111	2
C26	CAP,MICA,100PF,500V	DM15-101J	AMCO	1500-11-0100	1
C25	CAP,MICA,15PF,500V	DM15-150J	AMCO	1500-11-5000	1
C28 C31 C99T	CAP,MICA,220PF,500V	DM15-221J	AMCO	1500-12-2100	3

WAVETEK PARTS LIST	TITLE PCA,GENERATOR	ASSEMBLY NO 1100-00-0556 PAGE: 1	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	OWIG-MFGN-PART-NO	MFGN	WAVETEK NO.	QTY/PT
	CAP,SET,POLYC CONSIST:1509-90-0005 THRU:0007			1509-80-0008	
C39	CAP,POLYC,1MF,100V PART OF 1509-80-0008 QTY:011				
NONE	GENERATOR	1700-00-0556	WVTK	1700-00-0556	1
NONE	CONN,9PIN	09-60-1091	MOLEX	2100-02-0052	1
NONE	SOLDER LUG	1497	SMITH	2100-04-0012	5
NONE	TERM	200081	USECO	2100-05-0009	4
NONE	PIN,MALE	61182-2	AMP	2100-05-0020	18
NONE	HEAT SINK	HP-207	LAMB	2800-11-0001	2
NONE	TRANSIPAD	10123A	BERGS	2800-11-0003	2
NONE	THANSIPAD	10106	BERGS	2800-11-0004	4
NONE	HEATSINK	HP-209	LAMB	2800-11-0008	2
FB1	FERRITE BEAD	56-590-65/3M	FERRX	3100-00-0001	1
R4 R48	POT,TRIM,1K	91AM1A	BECK	4600-01-0209	2
R12 R162 R55	POT,TRIM,10K	91AM1A	BECK	4600-01-0315	3
R13 R16 R181 R252	POT,TRIM,100K	91AM1A	BECK	4600-01-0402	4
R107 R120 R93	POT,TRIM,200	91AR2UC	BECK	4600-02-0101	3

WAVETEK PARTS LIST	TITLE PCA,GENERATOR	ASSEMBLY NO 1100-00-0556 PAGE: 3	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	OWIG-MFGN-PART-NO	MFGN	WAVETEK NO.	QTY/PT
R161 R213 R281	RES,MF,1/8W,1%,20.9K	RN55D-2092F	TRW	4701-03-2092	3
R150 R177 R178 R203 R43	RES,MF,1/8W,1%,3.01K	RN55D-3011F	TRW	4701-03-3011	5
R131 R256	RES,MF,1/8W,1%,301K	RN55D-3013F	TRW	4701-03-3013	2
R134 R67 R71 R88 R89	RES,MF,1/8W,1%,316	RN55D-3160F	TRW	4701-03-3160	5
R101 R103 R109 R110 R119 R126 R130 R140 R187 R192 R204 R253 R269 R272 R65 R68 R69 R72 R75 R76 R79 R82 R95	RES,MF,1/8W,1%,33.2	RN55D-33R2F	TRW	4701-03-3329	23
R100 R105 R191 R202 R258 R80 R83	RES,MF,1/8W,1%,3.65K	RN55D-3651F	TRW	4701-03-3651	7
R115 R193 R194 R195	RES,MF,1/8W,1%,392	RN55D-3920F	TRW	4701-03-3920	4
R199 R42	RES,MF,1/8W,1%,8,02K	RN55D-4021F	TRW	4701-03-4021	2
R106 R205 R206 R207	RES,MF,1/8W,1%,464	RN55D-4640F	TRW	4701-03-4640	4
R201	RES,MF,1/8W,1%,46.4K	RN55D-4642F	TRW	4701-03-4642	1
R5	RES,MF,1,8W,1%,46.4	RN55D-46R4F	TRW	4701-03-4649	1
R34	RES,MF,1/8W,1%,4,75K	RN55D-4751F	TRW	4701-03-4751	1
R231 R259	RES,MF,1/8,1%,499	RN55D-4990F	TRW	4701-03-4990	2
R117 R14 R152 R20 R22 R232 R3 R37	RES,MF,1/8W,1%,4,99K	RN55D-4991F	TRW	4701-03-4991	8

WAVETEK PARTS LIST	TITLE PCA,GENERATOR	ASSEMBLY NO 1100-00-0556 PAGE: 6	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	OWIG-MFGN-PART-NO	MFGN	WAVETEK NO.	QTY/PT
C41T	CAP,MICA,36PF,500V	DM15-360J	AMCO	1500-13-6000	1
C46 C51	CAP,MICA,47PF,500V	DM15-470J	AMCO	1500-14-7000	2
C35T C47 C50	CAP,MICA,68PF,500V	DM15-680J	AMCO	1500-16-8000	3
C36	CAP,MICA,820PF,500V	DM15-821F	AMCO	1500-18-2101	1
C19	CAP,POLYC,1MF,100V	210-B1E-105F	ITHA	1500-41-0504	1
C34 C40	VARI,3.5-13PF,250V	73-TRIMU-02 3.5/13PF	TWICO	1500-51-3000	2
C12 C8 C96 C97	CAP,TANT,1MF,35V	150D105X9035A2	SPRAG	1500-71-0502	4
C69	CAP,TANT,22MF,15V	196D226X9015KA1	SPRAG	1500-72-2601	1
C95 C98	CAP,TANT,27MF,35V	196D276X0035FH	SPRAG	1500-72-7602	2
C111 C112 C64 C65	CAP,TANT,5.6MF,35V	150D565X9035B2	SPRAG	1500-75-6502	4
	CAP,SET,POLYC CONSIST:1509-90-0005 THRU:0007	180-501-101	WVTK	1509-80-0008	1
C37	CAP,POLYC,.01MF,100V PART OF 1509-80-0008 QTY:011				
C38	CAP,POLYC,.1MF,100V PART OF 1509-80-0008 QTY:011				

WAVETEK PARTS LIST	TITLE PCA,GENERATOR	ASSEMBLY NO 1100-00-0556 PAGE: 2	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	OWIG-MFGN-PART-NO	MFGN	WAVETEK NO.	QTY/PT
R35	POT,TRIM,500	91AM50U	BECK	4600-05-0104	1
R276 R30	POT,SWITCH,10K	GH-1879	CTS	4602-01-0300	2
R10	POT,CONT,10K FROM:4600-01-0312	4609-71-0301	WVTK	4609-71-0301	1
R185	POT,CONT,500 FROM:4600-05-0105	4609-75-0101	WVTK	4609-75-0101	1
R11 R8	RES,C,1/2W,10%,5.1K	MC20GF-515	STKPL	4700-25-5104	2
R17	RES,C,1/2W,10%,6.8M	MC20GF-685	STKPL	4700-25-6804	1
R118 R124 R127 R128 R129 R162 R165 R169 R153 R158 R174 R180 R214 R216 R69 R87 R73	RES,MF,1/8W,1%,100	RN55D-1000F	TRW	4701-03-1000	17
R104 R108 R111 R155 R165 R168 R200 R257 R45 R47 R51 R90 R98 R99	RES,MF,1/8W,1%,1K	RN55D-1001F	TRW	4701-03-1001	14
R112 R146 R265 R41	RES,MF,1/8W,1%,10K	RN55D-1002F	TRW	4701-03-1002	4
R116 R123 R139 R141 R172 R173 R198 R210 R236 R24 R273 R38 R50 R61 R64 R74 R81 R84	RES,MF,1/8W,1%,10	RN55D-10R0F	TRW	4701-03-1009	18
R211 R212	RES,MF,1/8W,1%,1.1K	RN55D-1101F	TRW	4701-03-1101	2
R239 R240 R250 R251	RES,MF,1/8W,1%,11K	RN55D-1102F	TRW	4701-03-1102	4

WAVETEK PARTS LIST	TITLE PCA,GENERATOR	ASSEMBLY NO 1100-00-0556 PAGE: 4	REV B

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROTENGR		TITLE PCA, GENERATOR
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030		MODEL NO 145
	DO NOT SCALE DWG		DWG NO 1100-00-0556 REV B
	SCALE		CODE IDENT 23338 SHEET 1 OF 2

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R157	RES,MF,1/8W,1%,49.9K	RN55D-4992F	TRW	4701-03-8992	1
R85T R92T	RES,MF,1/8W,1%,54.9	RN55D-54R9F	TRW	4701-03-5499	2
R235	RES,MF,1/8W,1%,56.2	RN55E-56R2F	TRW	4701-03-5629	1
R148T R243 R246	RES,MF,1/8W,1%,57Ω	RN55E-57R6F	TRW	4701-03-5760	3
R21 R40 R44 R86 R91	RES,MF,1/8W,1%,604	RN55D-6040F	TRW	4701-03-6040	5
R215 R217 R234 R244 R260 R268 R275	RES,MF,1/8W,1%,61.9	RN55D-61R9F	TRW	4701-03-6199	7
R264 R270	RES,MF,1/8W,1%,681	RN55D-6810F	TRW	4701-03-6810	2
R197 R208	RES,MF,1/8W,1%,68.1	RN55D-68R1F	TRW	4701-03-6819	2
R66	RES,MF,1/8W,1%,6.98K	RN55D-6981F	TRW	4701-03-6981	1
R135 R167 R190 R60 R70	RES,MF,1/8W,1%,750	RN55E-7500F	TRW	4701-03-7500	5
R133 R136 R138 R160 R164 R261 R266 R77 R78	RES,MF,1/8W,1%,7.5K	RN55D-7501F	TRW	4701-03-7501	9
R154	RES,MF,1/8W,1%,76.8K	RN55D-7682F	TRW	4701-03-7682	1
R125	RES,MF,1/8W,1%,825	RN55D-8250F	TRW	4701-03-8250	1
R238 R249 R58	RES,MF,1/8W,1%,8.25K	RN55D-8251F	TRW	4701-03-8251	3
R59	RES,MF,1/8W,1%,82.5	RN55D-82R5F	TRW	4701-03-8259	1
R122 R228	RES,MF,1/8W,1%,909	RN55D-9090F	TRW	4701-03-9090	2

WAVETEK PARTS LIST — TITLE: PCA,GENERATOR — ASSEMBLY NO. 1100-00-0556 — PAGE: 7 — REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
	RES,MF,SET,MATCHED CONSIST:4799-00-0043 THRU10045			4789-00-0043	
R56	RES,MF,,8W,1%,10M	ML-181	CADDO	4799-00-0003	1
CR16 CR3 CR33 CR4 CR5	DIODE	1N4581	MICRO	4801-01-4581	5
CR19 CR28 CR29 CR30 CR31 CR6 CR7 CR8 CR9	DIODE	FD-777	FAIR	4807-02-0777	9
CR1 CR10 CR11 CR14 CR15 CR17 CR18 CR20 CR21 CR22 CR23 CR24 CR25 CR27 CR32 CR34 CR35 CR36 CR37 CR46	DIODE	FD-6666	FAIR	4807-02-6666	20
CR12 CR13	DIODE	5082-2811	HP	4809-02-2811	2
CR2 CR26	DIODE,M/PR,FD-777 QTY:2:4807-02-0777	180-501-93	MVTK	4898-00-0004	1
CR38 CR39 CR40 CR41 CR42 CR43 CR44 CR45	DIODE,SET,8-FD-777 QTY:8:4807-02-0777	182-500-98	MVTK	4898-00-0010	1
Q42	TRANS	2N2219A	FAIR	4901-02-2191	1
Q43	TRANS	2N2905A	FAIR	4901-02-9051	1
Q12 Q36 Q50	TRANS	2N3563	FAIR	4901-03-5630	3
Q15 Q16 Q37 Q49	TRANS	2N3640	FAIR	4901-03-6400	4
Q39 Q44	TRANS	2N3866	MOT	4901-03-8660	2

WAVETEK PARTS LIST — TITLE: PCA,GENERATOR — ASSEMBLY NO. 1100-00-0556 — PAGE: 9 — REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
SW3	DETENT MOD FROM:5104-01-0010	5104-99-0029	MVTK	5104-99-0029	1
SW4	DETENT MOD FR 4151-4401-001	5104-99-0030	MVTK	5104-99-0030	1
NONE	WIRE,MU,22GA	150-BLACK	DAVIS	6000-32-2000	1
NONE	WIRE,MU,22GA	150-BROWN	DAVIS	6000-32-2001	1
NONE	WIRE,MU,22GA	150-RED	DAVIS	6000-32-2002	1
NONE	WIRE,MU,22GA	150-ORANGE	DAVIS	6000-32-2003	1
NONE	WIRE,MU,22GA	150-YELLOW	DAVIS	6000-32-2004	1
NONE	WIRE,MU,22GA	150-GREEN	DAVIS	6000-32-2005	1
NONE	WIRE,MU,22GA	150-BLUE	DAVIS	6000-32-2006	1
NONE	WIRE,MU,22GA	150-VIOLET	DAVIS	6000-32-2007	1
NONE	WIRE,MU,22GA	150-GRAY	DAVIS	6000-32-2008	1
NONE	WIRE,MU,22GA	150-WHITE/BLACK	DAVIS	6000-32-2090	1
NONE	WIRE,MU,22GA	150-WHITE/BROWN	DAVIS	6000-32-2091	1
NONE	WIRE,MU,22GA	150-WHITE/RED	DAVIS	6000-32-2092	1
NONE	WIRE,MU,22GA	150-WHITE/ORANGE	DAVIS	6000-32-2093	1
NONE	WIRE,MU,22GA	150-WHITE/YELLOW	DAVIS	6000-32-2094	1
NONE	WIRE,MU,22GA	150-WHITE/GREEN	DAVIS	6000-32-2095	1

WAVETEK PARTS LIST — TITLE: PCA,GENERATOR — ASSEMBLY NO. 1100-00-0556 — PAGE: 11 — REV H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R271	RES,MF,1/8W,1%,90.9	RN55D-90R9F	TRW	4701-03-9099	1
R7	RES,MF,1/4W,1%	RN60D-1004F	TRW	4701-13-1004	1
R233	RES,MF,1/4W,1%,121	RN60D-1210F	TRW	4701-13-1210	1
R229	RES,MF,1/4W,1%,124	RN60D-1240F	TRW	4701-13-1240	1
R175 R222 R274	RES,MF,1/4W,1%,49.9	RN60D-49R9F	TRW	4701-13-4999	3
R6T	RES,MF,1/4W,1%,698K	RN60D-6983F	TRW	4701-13-6983	1
R223 R280	RES,MF,1/4W,1%,75	RN60D-75R0F	TRW	4701-13-7500	2
R224 R225 R226 R227	RES,MF,1/2W,1%,49.9	RN65D-49R9F	TRW	4701-23-4999	4
	RES,MF,SET,MATCHED CONSIST:4799-00-0043 THRU10045	4789-00-0043	MVTK	4789-00-0043	1
R52	RES,MF,1/8W,1%,10K PART OF 4789-0043 QTY:01:4701-03-1002				
R53	RES,MF,1/8W,1%,100K PART OF 4789-00-0043 QTY:01:4701-03-1003				
R54	RES,MF,1/4W,1%,1M PART OF 4789-00-0043 QTY:01:4701-13-1004				

WAVETEK PARTS LIST — TITLE: PCA,GENERATOR — ASSEMBLY NO. 1100-00-0556 — PAGE: 8 — REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q13 Q21 Q22 Q25 Q27 Q28 Q29 Q31 Q40 Q6	TRANS	2N3903	FAIR	4901-03-9030	10
Q10 Q11 Q14 Q17 Q19 Q23 Q24 Q26 Q30 Q32 Q33 Q34 Q4 Q41 Q46 Q47 Q51	TRANS	2N3905	FAIR	4901-03-9050	17
Q38 Q45	TRANS	2N5160	MOT	4901-05-1600	2
Q18 Q20	TRANS,M/PR,2N3563 QTY:2:4901-03-5630	142-501-52	MVTK	4998-00-0004	1
Q2 Q3 Q7	TRANS,SEL,2N5962 QTY:1:4901-05-4620	142-501-55	MVTK	4998-00-0008	3
Q8 Q9	TRANS,M/PR,2N5485 QTY:2:4901-05-4850	142-501-53	MVTK	4998-00-0009	1
Q1 Q5	TRANS,SEL,2N5485 QTY:1:4901-05-4850	142-501-54	MVTK	4998-00-0010	2
SW1-A SW1-B SW1-C SW1-D SW1-E SW1-F SW4-A SW4-B SW4-C SW4-D SW4-E SW5-A SW5-B SW5-C	WAFER	147-400	MVTK	5104-02-0015	14
NONE	SWITCH STOP	211-33-001	CTS	5104-07-0001	1
NONE	SWITCH STOP	215-33-001-01-22	CTS	5104-07-0003	3
SW1	DETENT MOD FROM:5104-01-0010	5104-99-0028	MVTK	5104-99-0028	1

WAVETEK PARTS LIST — TITLE: PCA,GENERATOR — ASSEMBLY NO. 1100-00-0556 — PAGE: 10 — REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
IC4 IC5	IC	MA-741	FAIR	7000-07-8100	2
U35 Q48	IC	AD 612	ANDEV	7000-08-1200	2
IC1 IC2 IC6	IC	MC1458P	MOT	7000-18-5800	3
IC9	IC	CA-3049	RCA	7000-30-4900	1
IC7 IC8	IC	CA3140E	RCA	7000-31-4001	2

WAVETEK PARTS LIST — TITLE: PCA,GENERATOR — ASSEMBLY NO. 1100-00-0556 — PAGE: 12 — REV B

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE: PCA, GENERATOR
	RELEASE APPROV		
FINISH: WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.06		
	DO NOT SCALE DWG		MODEL NO: 145 — DWG NO: 1100-00-0556 — REV: B
	SCALE		COST CODE: 23338 — SHEET 2 OF 2

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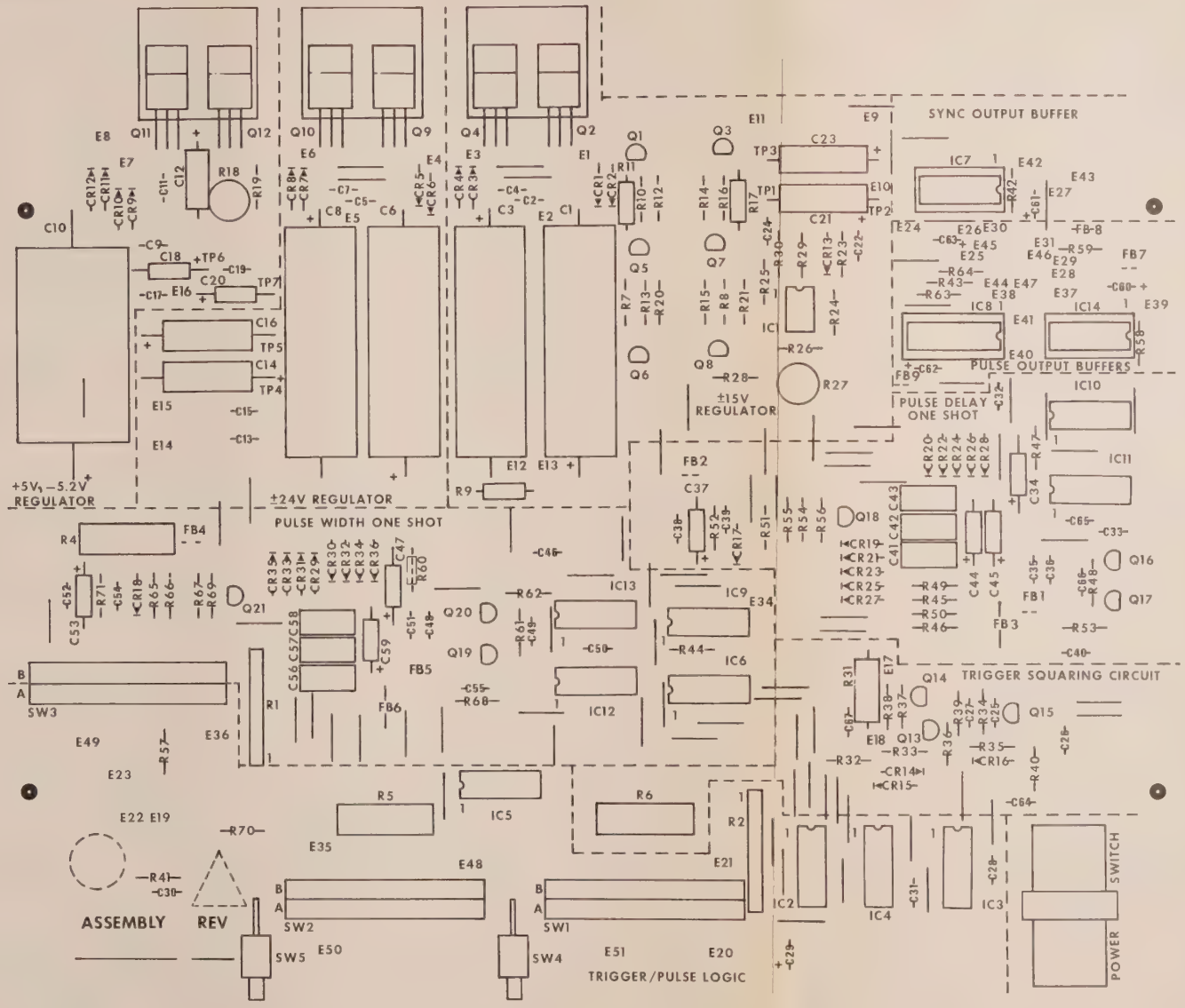
REV	ECN	BY	DATE	APP



NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: TRIG/PULSE BOARD PARTS LOCATER
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ± .010 ANGLES ± 1 .XX ± .030		
	DO NOT SCALE DWG		MODEL NO 143/145 · DWG NO 0100-00-0565 · REV C
	SCALE		CODE IDENT 23338 · SHEET OF

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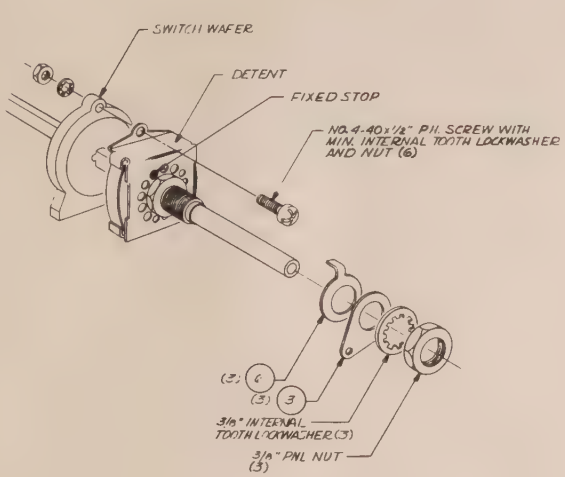
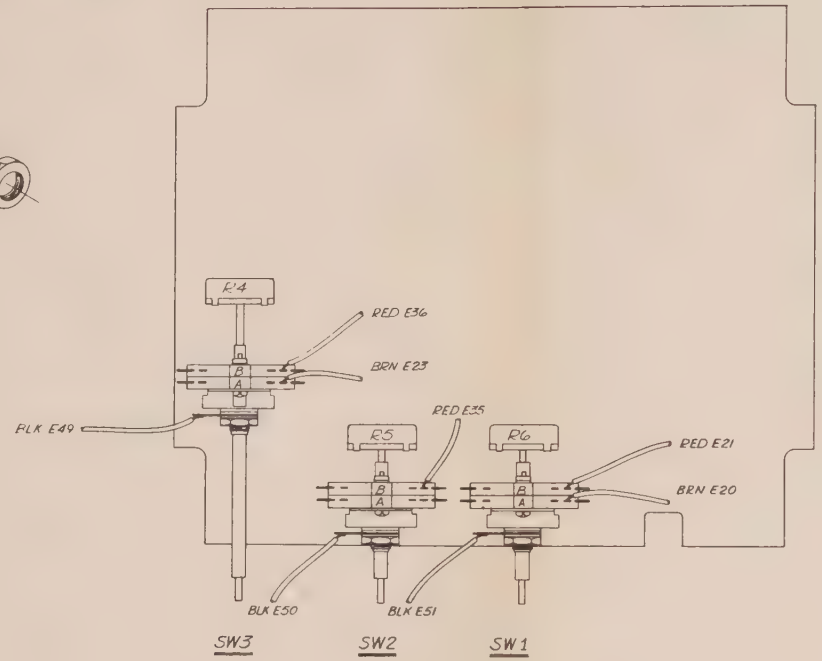
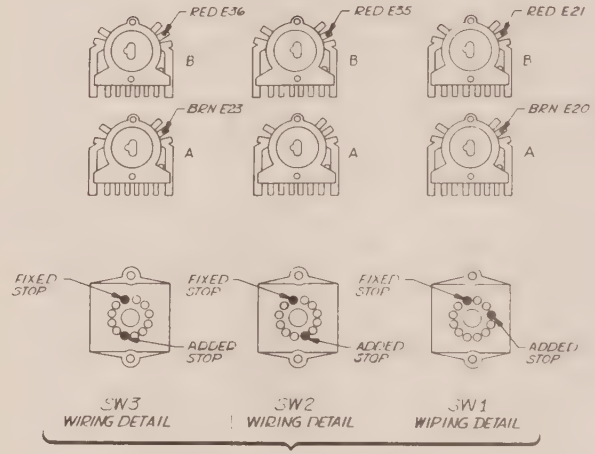
REV	ECN	BY	DATE	APP



TYPICAL HARDWARE STACK-UP





DETENT SHOWN FROM FRONT VIEW IN FULL COUNTER CLOCKWISE POSITION

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 4/27/77	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR	5-27-77	TITLE: ASSEMBLY TRIG/PULSE BD.
FINISH WAVETEK PROCESS	RELEASE SIGNATURE		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX .010 ANGLES 1 XX .030		
	DO NOT SCALE DWG		MODEL NO 145 / DWG NO 010-00-0565 / REV A
	SCALE		CODE IDENT 23338 / SHEET 2 OF 2

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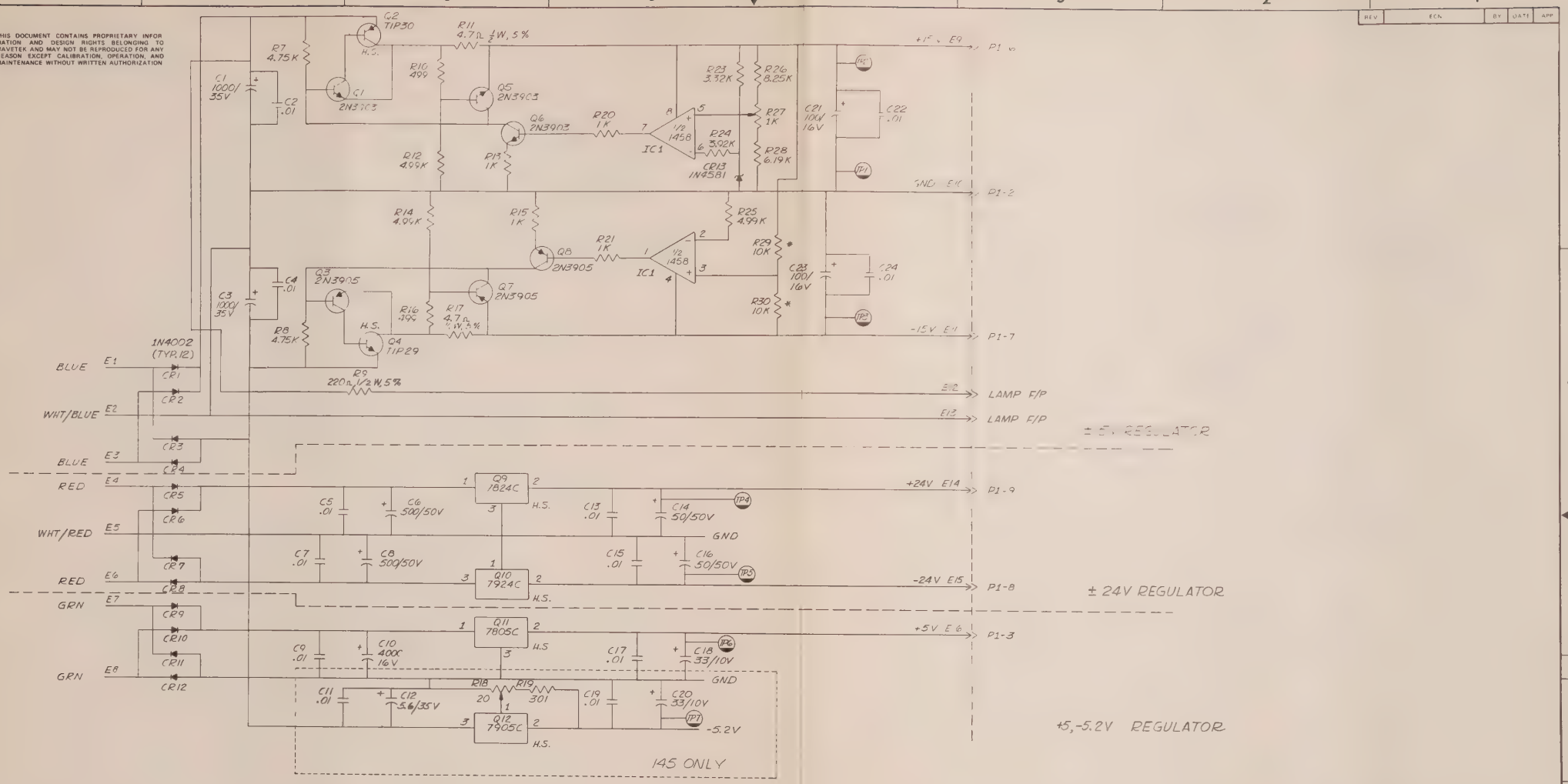


LAST REF DES USED
C67
CR36
FB9
IC14
R71
S1V4
R21

4. RESISTORS ARE 1/8W, 1%, MF
3. RESISTANCE IN OHMS
2. CAPACITANCE IN MICROFARADS
1. * = M.P. 10K RESISTORS

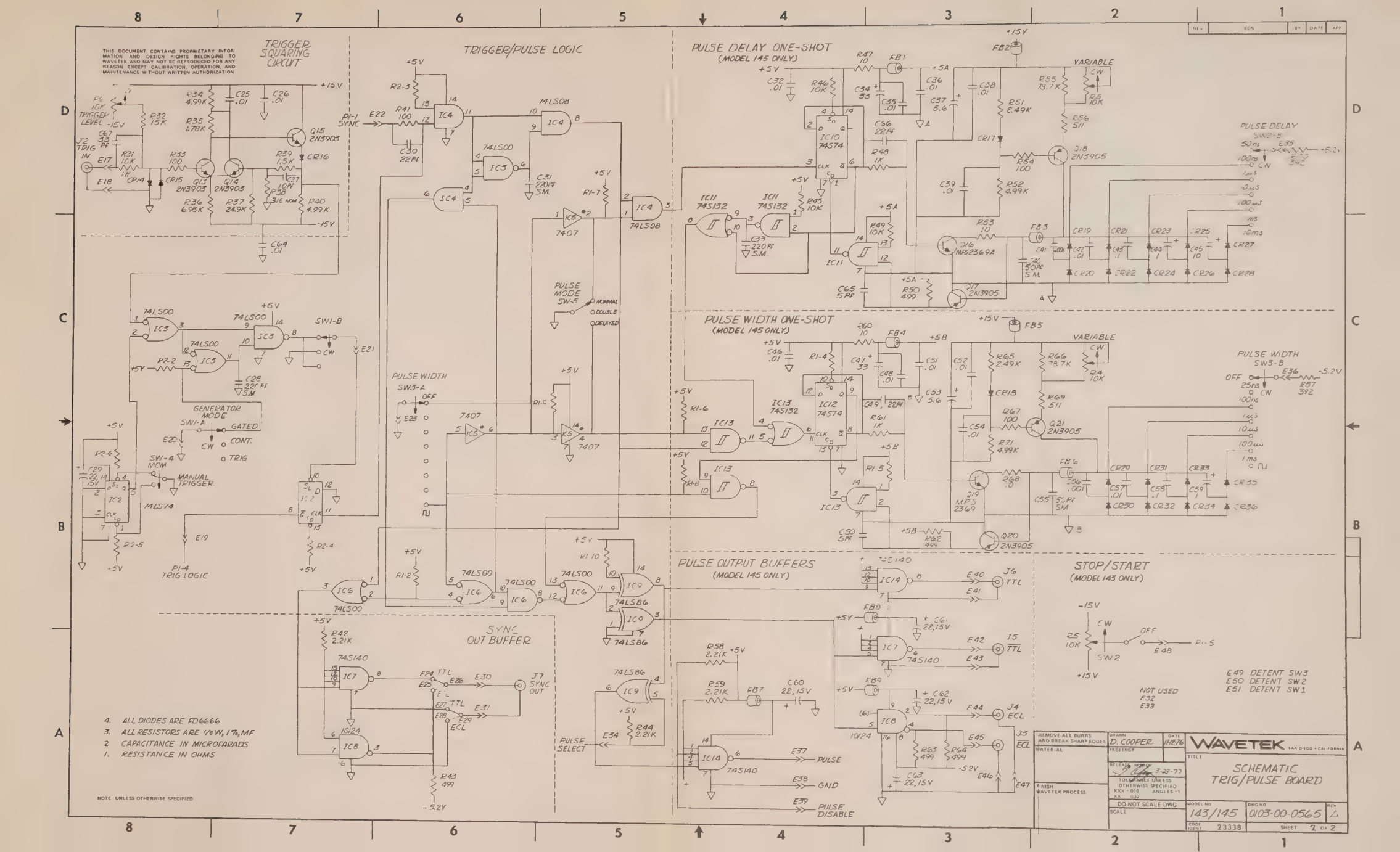
NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DRAWN D. COOPER DATE 11/6/76
PROJENGR
RELEASE AGENCY
TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1 XX ± .030
DO NOT SCALE DWG
SCALE

WAVETEK SAN DIEGO, CALIFORNIA

TITLE
SCHEMATIC
TRIG/PULSE BOARD

MODEL NO 143/145
DWG NO 0.03-00-0566
REV A
CODE IDENT 23338
SHEET 1 OF 2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TRIGGER SQUARING CIRCUIT
TRIGGER/PULSE LOGIC
PULSE DELAY ONE-SHOT
(MODEL 145 ONLY)
PULSE WIDTH ONE-SHOT
(MODEL 145 ONLY)
PULSE OUTPUT BUFFERS
(MODEL 145 ONLY)
STOP/START
(MODEL 143 ONLY)
SYNC OUT BUFFER
GENERATOR MODE
PULSE MODE SW-5
PULSE WIDTH SW3-A
PULSE WIDTH SW3-B
PULSE DELAY SW2-B
MANUAL TRIGGER
P1-4 TRIG LOGIC
P1-1 SYNC
PULSE SELECT
PULSE
GND
PULSE DISABLE
NOT USED
E32
E33
E49 DETENT SW3
E50 DETENT SW2
E51 DETENT SW1
4. ALL DIODES ARE FD6666
3. ALL RESISTORS ARE 1/8W, 1%, MF
2 CAPACITANCE IN MICROFARADS
1. RESISTANCE IN OHMS
NOTE UNLESS OTHERWISE SPECIFIED
WAVETEK SAN DIEGO • CALIFORNIA
SCHEMATIC
TRIG/PULSE BOARD
MODEL NO 143/145
DWG NO 0103-00-0565
REV A
SHEET 2 OF 2
CODE IDENT 23338

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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY ORIG TRIG/PULSE	0101-00-0565	WVTK	0101-00-0565	1
NONE	SCHEMATIC TRIG/PULSE	0103-00-0565	WVTK	0103-00-0565	1
NONE	BRKT,HEAT SINK	182-308	WVTK	1400-00-5143	3
C50 C65	CAP,CER,.5PF,1KV	UD-050	CML	1500-00-5011	2
C27	CAP,CER,10PF,1KV	UD-100	CML	1500-01-0011	1
C11 C13 C15 C17 C19 C2 C22 C24 C25 C26 C34 C35 C36 C38 C39 C4 C40 C48 C5 C51 C52 C54 C64 C7 C9	CAP,CER,.01MF,50V	CK-103	CML	1500-01-0310	25
C30 C49 C66	CAP,CER,22PF,1KV	UD-220	CML	1500-02-2011	3
C47	CAP,CER,33PF,1KV	UD-330	CML	1500-03-3011	1
C28 C31 C33	CAP,MICA,220PF,500V	DM15-221J	AMCO	1500-12-2100	3
C40 C55	CAP,MICA,50PF,500V	DM15-500J	AMCO	1500-15-0000	2
C21 C23	CAP,ELECT,100MF,16V	500D107G016DC7	SPRAG	1500-31-0101	2
C1 C3	CAP,ELECT,1000MF,35V	3VD108G035GL6	SPRAG	1500-31-0212	2
C10	CAP,ELECT,4000MF,15V	TC6402U015NIL	MAL	1500-34-0211	1
C14 C16	CAP,ELELT,50MF,50V	500D506G050DD7	SPRAG	1500-35-0003	2
C6 C8	CAP,ELECT,500MF,50V	39D507G050GL4	SPRAG	1500-35-0103	2
C61 C58	CAP,MYLAR,.001MF100V	225P1029Y1H03	SPRAG	1500-41-0208	2

WAVETEK PARTS LIST | TITLE PCA,TRIGGER/PULSE | ASSEMBLY NO 1100-00-0565 PAGE: 1 | REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C62 C57	CAP,MYLAR,.01MF,100V	225P10391H03	SPRAG	1500-41-0314	2
C63 C58	CAP,POLYE,.1MF,100V	225P10491A03	SPRAG	1500-41-0844	2
C44 C59	CAP,TANT,1MF,35V	150D105X9035A2	SPRAG	1500-71-0502	2
C45	CAP,TANT,10MF,20V	150D106X9020B2	SPRAG	1500-71-0601	1
C29 C60 C61 C62 C63	CAP,TANT,.22MF,15V	196D226X9015KA1	SPRAG	1500-72-2601	5
C18 C20 C36 C47	CAP,TANT,.33MF,10V	150D336X9010H2	SPRAG	1500-73-3601	4
C12 C37 C53	CAP,TANT,5.6MF,35V	150D565X9035H2	SPRAG	1500-75-6502	3
NONE	TRIGGER/PULSE	1700-00-0565	WVTK	1700-00-0565	1
A2P1	CONN,9PIN	09-50-7091	MOLEX	2100-02-0051	1
NONE	SKT,IC,14PIN	14-DIP	CINCH	2100-03-0011	2
NONE	SKT,IC,16PIN	16-DIP	CINCH	2100-03-0022	1
NONE	SOLDER LUG	1497	SMITH	2100-04-0012	3
NONE	PIN	08-50-0105	MOLEX	2100-05-0025	9
NONE	STANDOFF	P-609-M03-F05-440	WVTK	2800-02-0016	4
FB1 FB2 FB3 FB4 FB5 FB6 FB7 FB8 FB9	FERRITE BEAD	56-590-65/3B	FERRX	5100-00-0001	9
R27	POT,TRIM,1K	91AW1K	BECK	4600-01-0209	1
R18	POT,TRIM,20	91AW20	BECK	4600-02-0000	1

WAVETEK PARTS LIST | TITLE PCA,TRIGGER/PULSE | ASSEMBLY NO. 1100-00-0565 PAGE: 2 | REV H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R8	POT,CONT,10K FROM:4600-01-0312	4609-71-0302	WVTK	4609-71-0302	1
R5 R6	POT,CONT,10K FROM:4600-01-0312	4609-71-0303	WVTK	4609-71-0303	2
R11 R17	RES,C,1/2W,5%,4.7	RC20GF-4R7	STKPL	4700-25-0479	2
R9	RES,C,1/2W,5%,220	RC20GF-221	STKPL	4700-25-2200	1
R31	RES,C,1W,10%,10M	RC32GF-103	STKPL	4700-35-1002	1
R33 R41 R54 R67	RES,MF,1/8W,1%,100	RN55D-1000F	TRW	4701-03-1000	4
R13 R15 R20 R21 R48 R61	RES,MF,1/8W,1%,1K	RN55D-1001F	TRW	4701-03-1001	6
R45 R46 R49	RES,MF,1/8W,1%,10K	RN55D-1002F	TRW	4701-03-1002	3
R47 R53 R60 R68	RES,MF,1/8W,1%,10	RN55D-10R0F	TRW	4701-03-1009	4
R34	RES,MF,1/8W,1%,1.5K	RN55D-1501F	TRW	4701-03-1501	1
R32	RES,MF,1/8W,1%,15K	RN55D-1502F	TRW	4701-03-1502	1
R35	RES,MF,1/8W,1%,1.78K	RN55D-1781F	TRW	4701-03-1781	1
R42 R44 R58 R59	RES,MF,1/8W,1%,2.21K	RN55D-2211F	TRW	4701-03-2211	4
R51 R65	RES,MF,1/8W,1%,2.49K	RN55D-2491F	TRW	4701-03-2491	2
R37	RES,MF,1/8W,1%,24.9K	RN55D-2492F	TRW	4701-03-2492	1
R14	RES,MF,1/8W,1%,301	RN55D-3010F	TRW	4701-03-3010	1

WAVETEK PARTS LIST | TITLE PCA,TRIGGER/PULSE | ASSEMBLY NO 1100-00-0565 PAGE: 3 | REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R23	RES,MF,1/8W,1%,3.32K	RN55D-3321F	TRW	4701-03-3321	1
R38 R57 R70	RES,MF,1/8W,1%,392	RN55D-3920F	TRW	4701-03-3920	3
R24	RES,MF,1/8W,1%,3.92K	RN55D-3921F	TRW	4701-03-3921	1
R7 R8	RES,MF,1/8W,1%,4.75K	RN55D-4751F	TRW	4701-03-4751	2
R10 R16 R43 R50 R62 R63 R64	RES,MF,1/8,1%,499	RN55D-499DF	TRW	4701-03-4990	7
R12 R14 R25 R36 R40 R52 R71	RES,MF,1/8W,1%,4.99K	RN55D-4991F	TRW	4701-03-4991	7
R56 R69	RES,MF,1/8W,1%,511	RN55D-5110F	TRW	4701-03-5110	2
R28	RES,MF,1/8W,1%,6.19K	RN55D-6191F	TRW	4701-03-6191	1
R39	RES,MF,1/8W,1%,6.98K	RN55D-6981F	TRW	4701-03-6981	1
R55 R66	RES,MF,1/8W,1%,78.7K	RN55D-7872F	TRW	4701-03-7872	2
R26	RES,MF,1/8W,1%,8.25K	RN55D-8251F	TRW	4701-03-8251	1
R1 R2	RES MODULE	4310M-101-103	BOURN	4770-00-0008	2
R29 R30	RES,SET,2-10K,1/8W QTY1214/01-03-1002	142-501-60A	WVTK	4789-00-0019	1
CR13	DIODE	1N4581	MICRO	4801-01-4581	1
CR1 CR10 CR11 CR12 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	DIODE	3Cb-1	SEMTC	4801-02-0001	12

WAVETEK PARTS LIST | TITLE PCA,TRIGGER/PULSE | ASSEMBLY NO 1100-00-0565 PAGE: 4 | REV H

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES | MATERIAL | FINISH WAVETEK PROCESS | DRAWN | DATE | PROJ/ENGR | RELEASE APPROV | TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030 | DO NOT SCALE DWG | SCALE

WAVETEK SAN DIEGO, CALIFORNIA

TITLE: PCA, TRIGGER/ PULSE

MODEL NO 145 | DWG NO 1100-00-0565 | REV B | CODE IDENT 23338 | SHEET 1 OF 2

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REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR21 CR22 CR23 CR24 CR25 CR26 CR27 CR28 CR29 CR30 CR31 CR32 CR33 CR34 CR35 CR36	DIODE	FD-6666	FAIR	4807-02-6866	23
Q1 Q13 Q14 Q15 Q5 Q6	TRANS	2N3903	FAIR	4901-03-9030	6
Q17 Q18 Q20 Q21 Q3 Q7 Q8	TRANS	2N3905	FAIR	4901-03-9050	7
Q4	TRANS	TIP-29	TI	4902-00-0290	1
Q2	TRANS	TIP-30	TI	4902-00-0300	1
Q16 Q19	TRANS	MPS-2369	FAIR	4902-02-3690	2
SW1-A SW1-B SW2-A SW2-B SW3-A SW3-B	WAFER	147-400	WVTK	5104-02-0015	6
NONE	SWITCH STOP	215-33-001-01-22	CTS	5104-07-0003	3
SW1 SW2	DETENT MOD FROM:5104-01-0010	5104-99-0031	WVTK	5104-99-0031	2
SW3	DETENT MOD FROM:5104-01-0010	5104-99-0032	WVTK	5104-99-0032	1
SW5	SWITCH,TOGGLE	7103P3Y9AVQ	C&K	5106-00-0019	1
SW4	SWITCH,TOGGLE	7108P3Y9AVQ	C&K	5106-00-0020	1
NONE	WIRE,MU,22GA	15U-BROWN	GAVTT	6000-32-2001	1

WAVETEK PARTS LIST | TITLE PCA,TRIGGER/PULSE | ASSEMBLY NO. 1100-00-0565 | PAGE: 5 | REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	WIRE,MU,22GA	15U-RED	GAVTT	6000-32-2002	2
NONE	WIRE,MU,22GA	15U-ORANGE	GAVTT	6000-32-2003	2
NONE	WIRE,MU,22GA	15U-YELLOW	GAVTT	6000-32-2004	2
NONE	WIRE,MU,22GA	15U-GREEN	GAVTT	6000-32-2005	2
NONE	WIRE,MU,22GA	15U-BLUE	GAVTT	6000-32-2006	2
NONE	WIRE,MU,22GA	15U-VIOLET	GAVTT	6000-32-2007	2
NONE	WIRE,MU,22GA	15U-GRAY	GAVTT	6000-32-2008	2
NONE	WIRE,MU,22GA	15U-WHITE	GAVTT	6000-32-2009	2
NONE	WIRE,MU,22GA	15U-WHITE/BLACK	GAVTT	6000-32-2090	2
NONE	WIRE,MU,22GA	15U-WHITE/BROWN	GAVTT	6000-32-2091	2
NONE	WIRE,MU,22GA	15U-WHITE/RED	GAVTT	6000-32-2092	2
NONE	WIRE,MU,22GA	15U-WHITE/ORANGE	GAVTT	6000-32-2093	1
NONE	WIRE,MU,22GA	15U-WHITE/YELLOW	GAVTT	6000-32-2094	1
NONE	WIRE,MU,22GA	15U-WHITE/GREEN	GAVTT	6000-32-2095	1
NONE	WIRE,MU,22GA	15U-WHITE/BLUE	GAVTT	6000-32-2096	1
NONE	WIRE,MU,22GA	15U-WHITE/VIOLET	GAVTT	6000-32-2097	1
NONE	CABLE,COAX,26AWG	RG 174/U	ITT	6001-80-0001	8
IC1	IC	MC1458P	MOT	7000-14-5800	1

WAVETEK PARTS LIST | TITLE PCA,TRIGGER/PULSE | ASSEMBLY NO. 1100-00-0565 | PAGE: 6 | REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q9	IC	7820	FAIR	7000-78-2400	1
Q12	IC	MC7905CP	MOT	7000-79-0500	1
Q10	IC	7920	FAIR	7000-79-2400	1
IC3 IC6	IC	74LS00	TI	8000-74-0010	2
IC5	IC	7407	TI	8000-74-0700	1
IC4	IC	74LS08	TI	8000-74-0810	1
IC10 IC12	IC	74S74	TI	8000-74-7401	2
IC2	IC	74LS74	TI	8000-74-7410	1
IC9	IC	74LS86	TI	8000-74-8610	1
Q11	VOLTAGE REGULATOR	7805393	FAIR	8000-78-0500	1
IC8	IC	MC10124P	MOT	8001-01-2400	1
IC11 IC13	IC	74S132	TI	8007-41-3201	2
IC14 IC7	IC	74S140	TI	8007-41-4001	2

WAVETEK PARTS LIST | TITLE PCA,TRIGGER/PULSE | ASSEMBLY NO. 1100-00-0565 | PAGE: 7 | REV B

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: PCA, TRIGGER/PULSE
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 XX ±.030 ANGLES ±1°		MODEL NO. 145
	DO NOT SCALE DWG		DWG NO. 1100-00-0565 REV B
	SCALE		CODE IDENT 23338 SHEET 2 OF 2

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